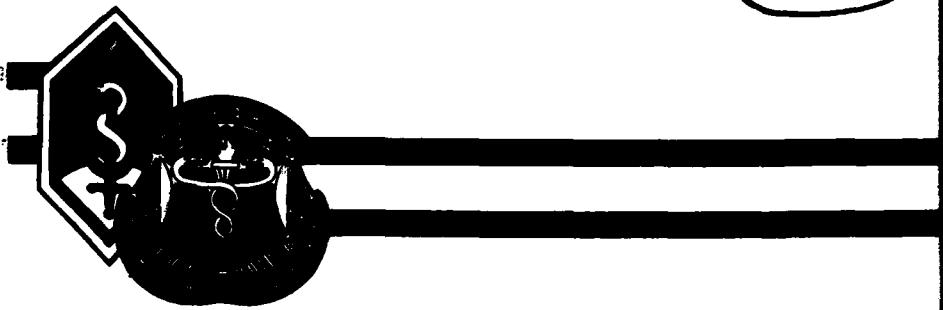


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**USAARL Report No. 91-6
Volume II**

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■ **AD-A232 907**



**The Airbag as a Supplement
to Standard Restraint Systems
in the AH-1 and AH-64 Attack Helicopters
and Its Role in Reducing Head Strikes
of the Copilot/Gunner**

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By

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and

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**Naval Biodynamics Laboratory
New Orleans, Louisiana**

January 1991

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**United States Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362-5292**

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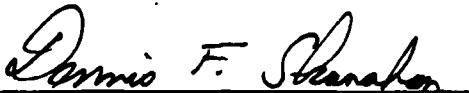
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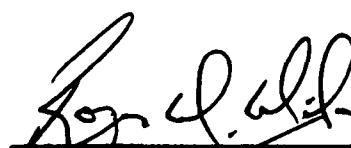
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19. ABSTRACT (Continue on reverse if necessary and identify by block number) Accident investigation records of U.S. Army helicopter crashes show injuries of pilots due to striking a structure inside the cockpit outnumber those due to excessive accelerations by a five-to-one ratio. This two-volume report presents the results of a study of the effectiveness of airbags in reducing the severity of contact injury to the gunner when striking the gunsight. Airbag systems were installed on the gunsights in simulated Cobra and Apache cockpits, then sled tested at 7 and 25 g. The tests indicated airbags reduced head accelerations by 65 percent, head injury criteria by 77 percent, and head angular acceleration by 76 percent in the Cobra tests. In the Apache tests, the airbags reduced those same indicators by 68, 52, and 83 percent. An airbag system, the report concludes, is likely to prevent severe or fatal head and chest injuries in an Apache or Cobra crash. Volume 1 of the report describes the tests and discusses the results. Volume 2 consists of Appendixes A, B, and C of the report and contains processed signal graphs of all sled tests.				
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Appendix A

This appendix contains the processed transducer signals from the 11 (Cobra) telescopic sighting unit (TSU) tests with inertia reels and without airbags.

These include eight tests (LX6196 - LX6204) conducted during the first phase of testing and three tests (LX6274 - LX6276) which were run in the second phase.

Figures A-1 thru A-11 show the sled acceleration pulses and computed velocity and jerk signals for the 11 tests.

Figures A-12 thru A-22 display available components and resultants head linear accelerations.

Figures A-23 thru A-33 display the head roll acceleration signals and computed angular velocities and displacements.

Figures A-34 thru A-44 show the head pitch acceleration signals and computed angular velocities and displacements.

Figures A-45 thru A-55 display the amounts of belt extension and the computed velocities and accelerations.

Appendix A

- 1. LX6196**
- 2. LX6197**
- 3. LX6198**
- 4. LX6199**
- 5. LX6200**
- 6. LX6201**
- 7. LX6203**
- 8. LX6204**
- 9. LX6274**
- 10. LX6275**
- 11. LX6276**

Test: LX6196

maxima:
minima:

19.64 G
-.45

11.06 m/s
.00

2253 G/s
-940

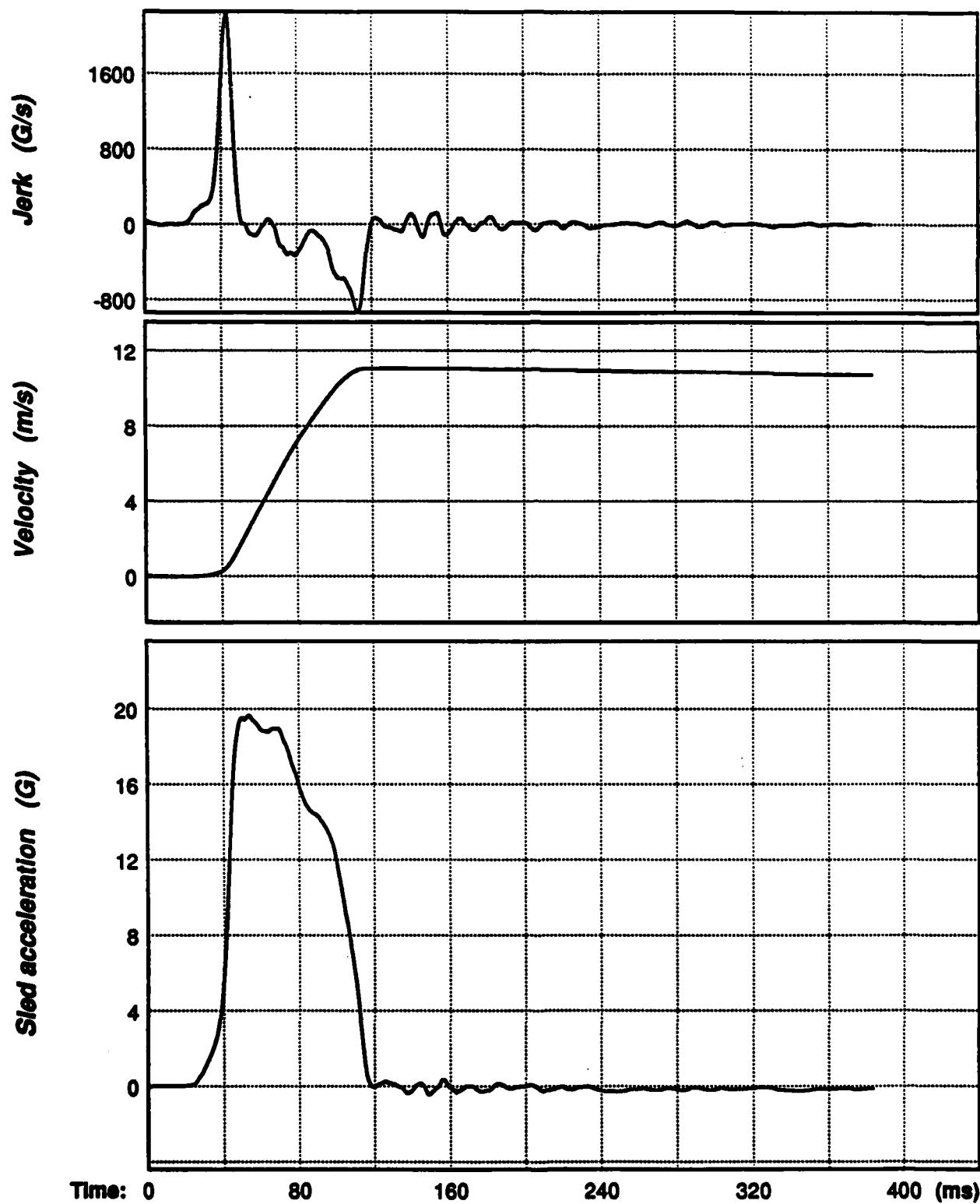


Figure A-1. Sled acceleration signal and its computed velocity and jerk for test LX6196.

Test: LX6197

maxima:
minima:

19.59 G
-.58

10.97 m/s
.00

2291 G/s
-1040

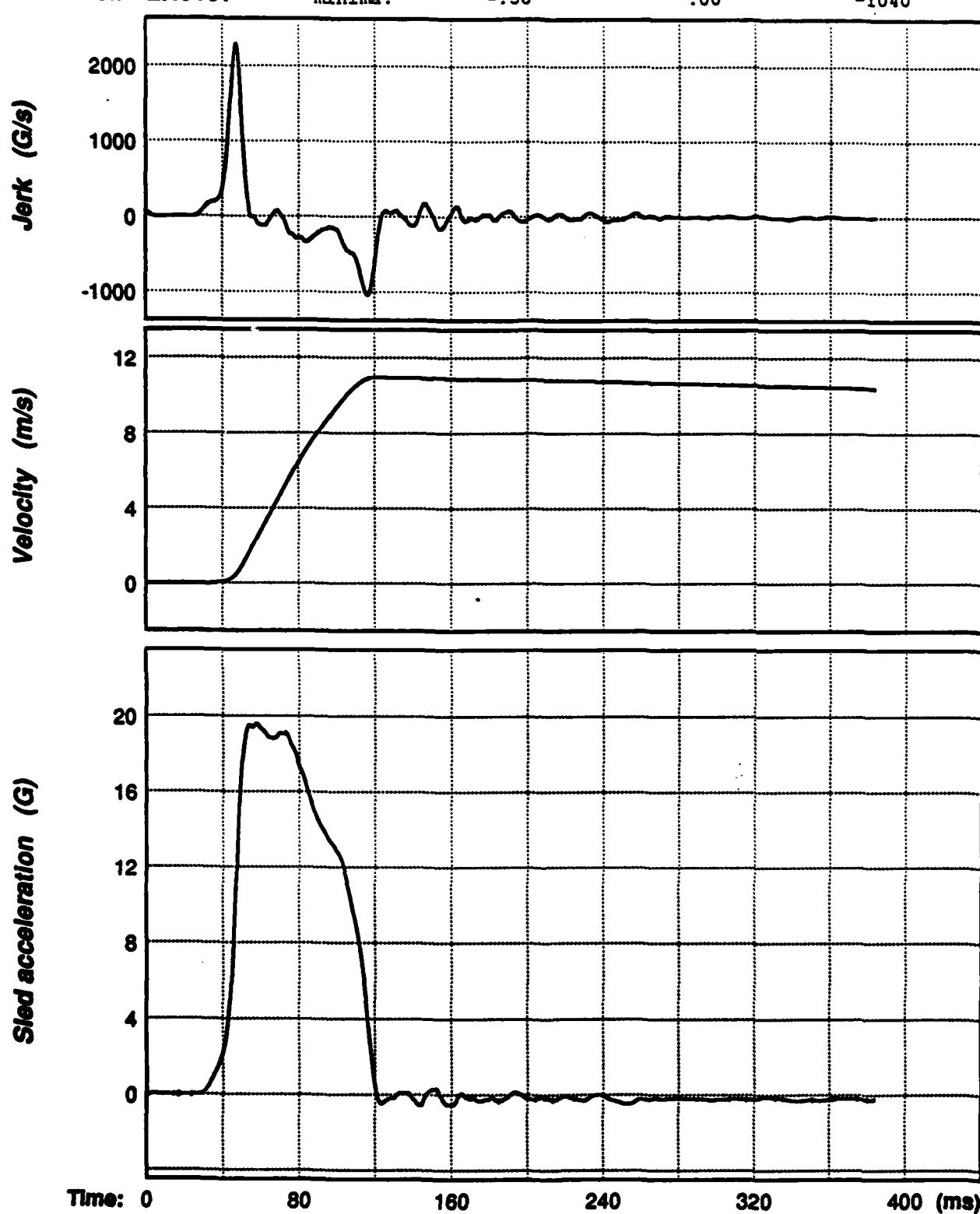


Figure A-2. Sled acceleration signal and its computed velocity and jerk for test LX6197.

Test: LX6198 maxima: 19.57 G 10.96 m/s 2288 G/s
minima: -.63 -.01 -990

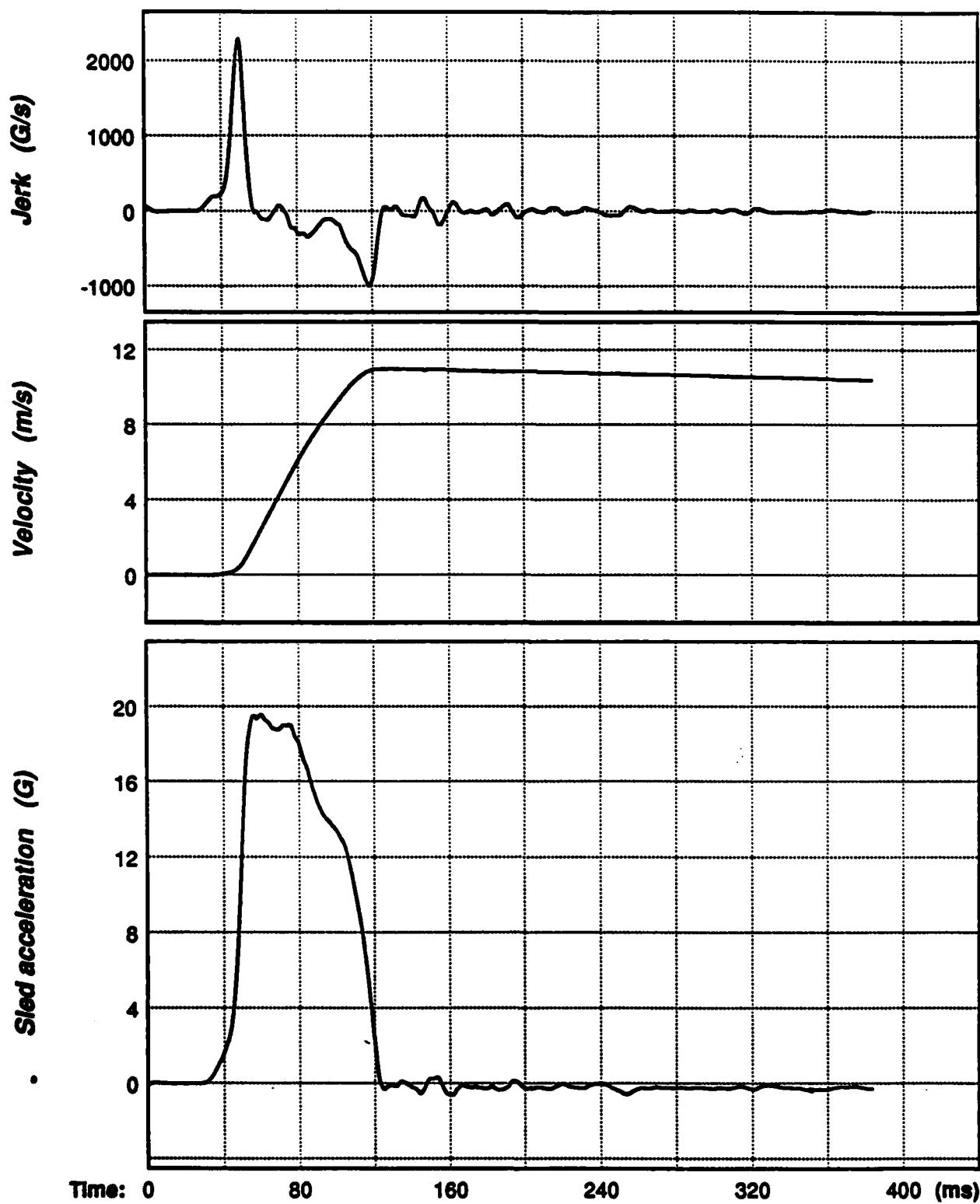


Figure A-3. Sled acceleration signal and its computed velocity and jerk for test LX6198.

Test: LX6199 maxima: 23.47 G 12.01 m/s 2821 G/s
minima: -.53 .00 -1149

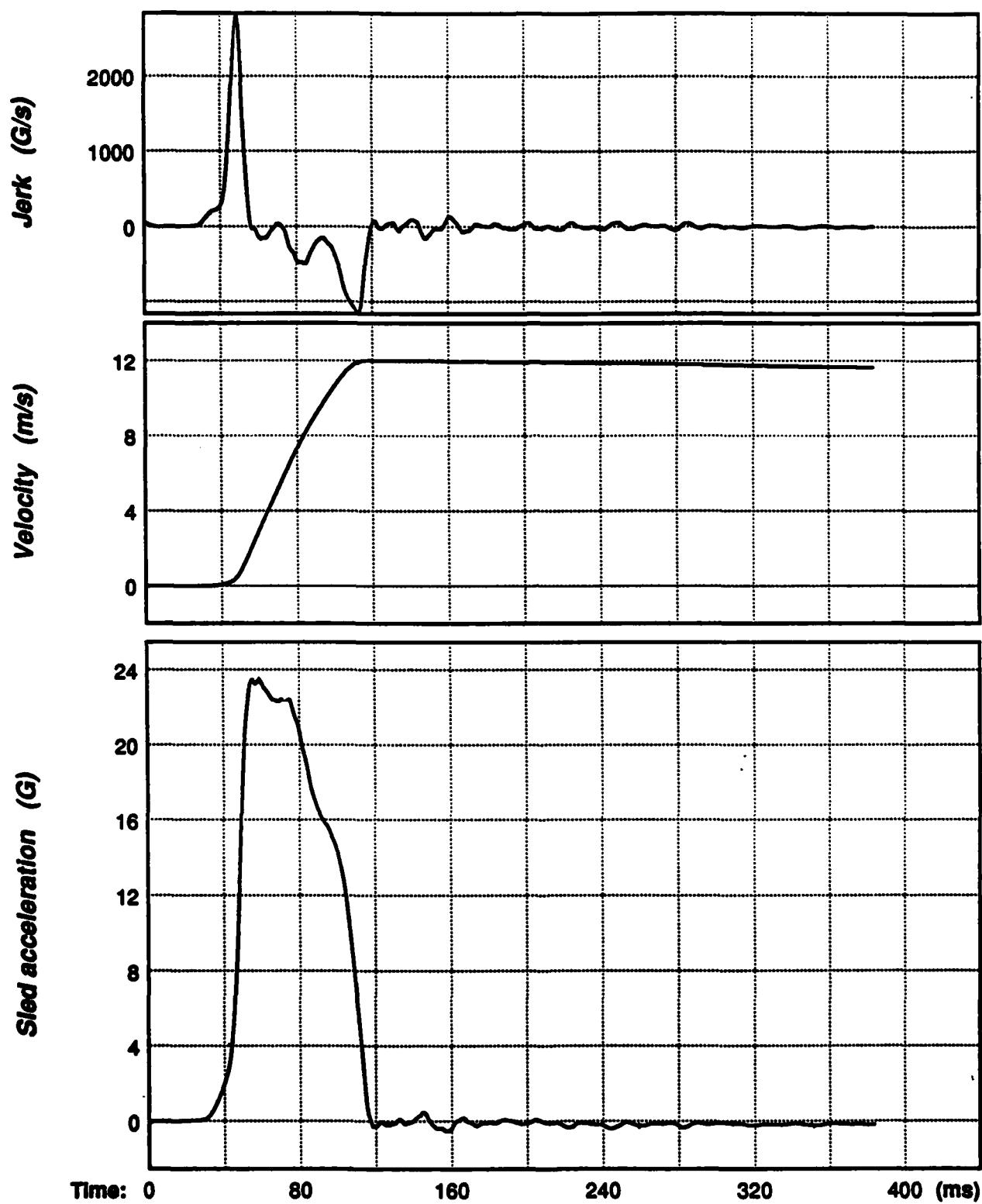


Figure A-4. Sled acceleration signal and its computed velocity and jerk for test LX6199.

Test: LX6200 maxima: 23.42 G 11.97 m/s 2833 G/s
 minima: -.56 .00 -1157

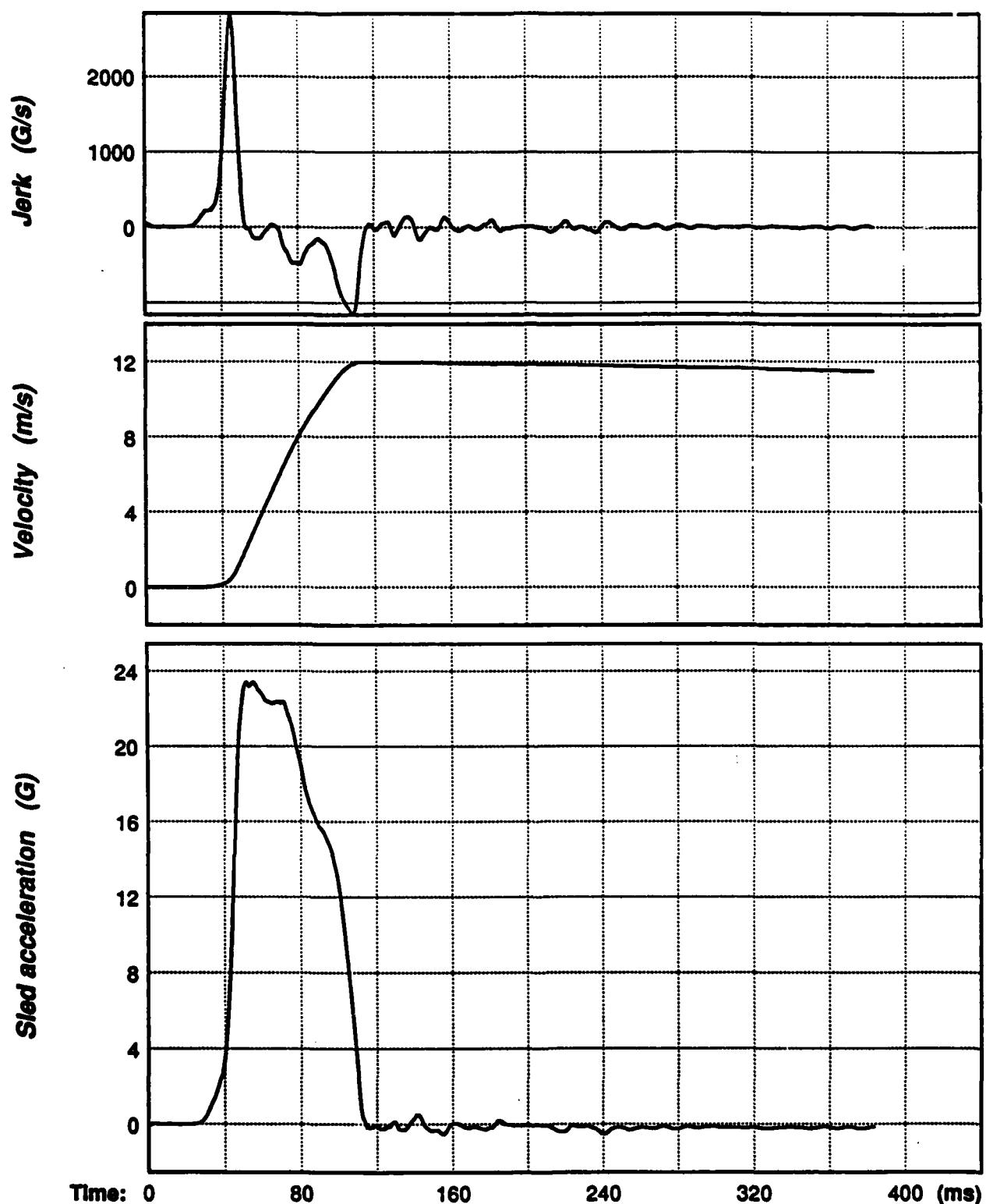


Figure A-5. Sled acceleration signal and its computed velocity and jerk for test LX6200.

Test: LX6201 maxima: 23.41 G 11.99 m/s 2828 G/s
 minima: -.52 .00 -1168

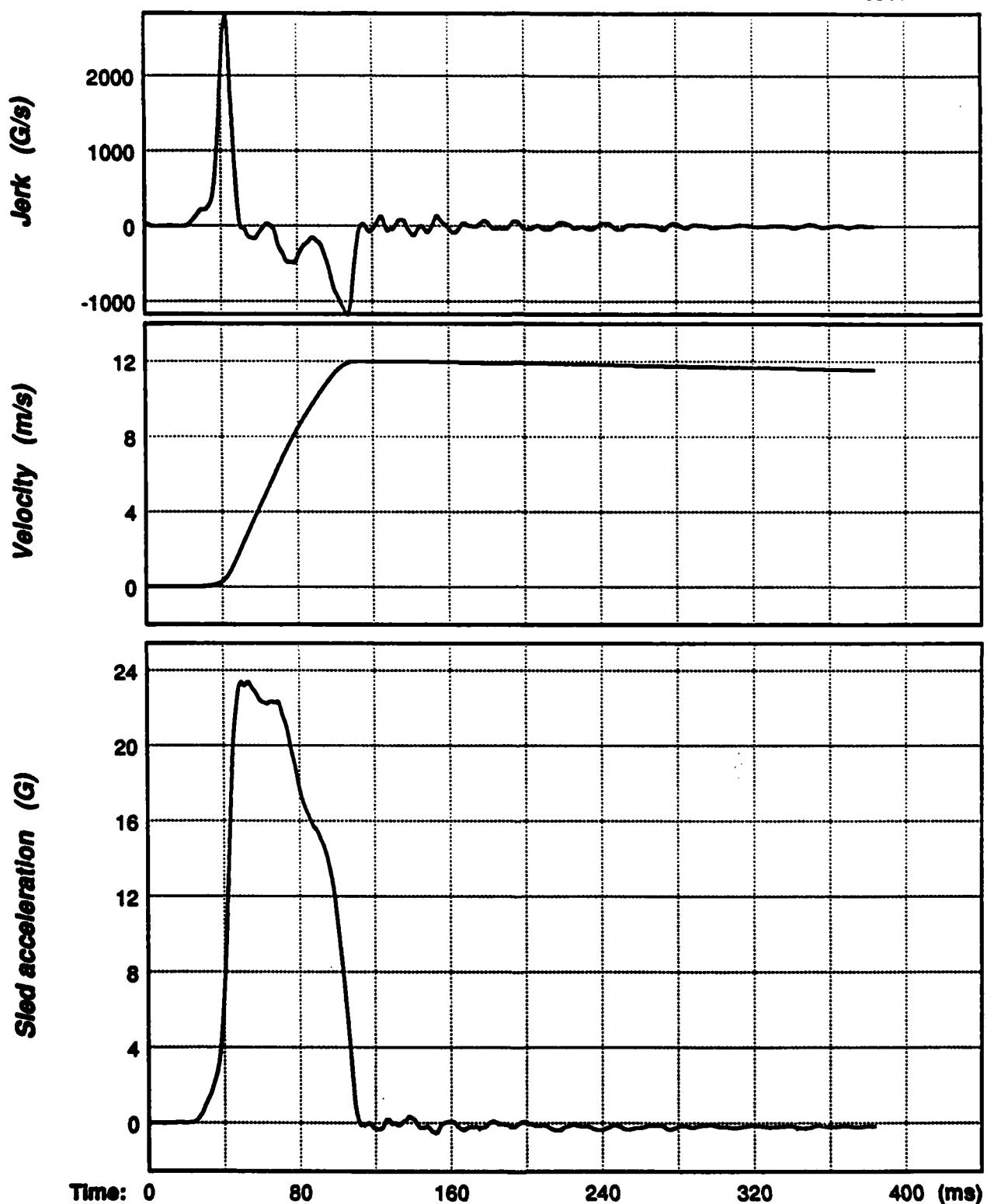


Figure A-6. Sled acceleration signal and its computed velocity and jerk for test LX6201.

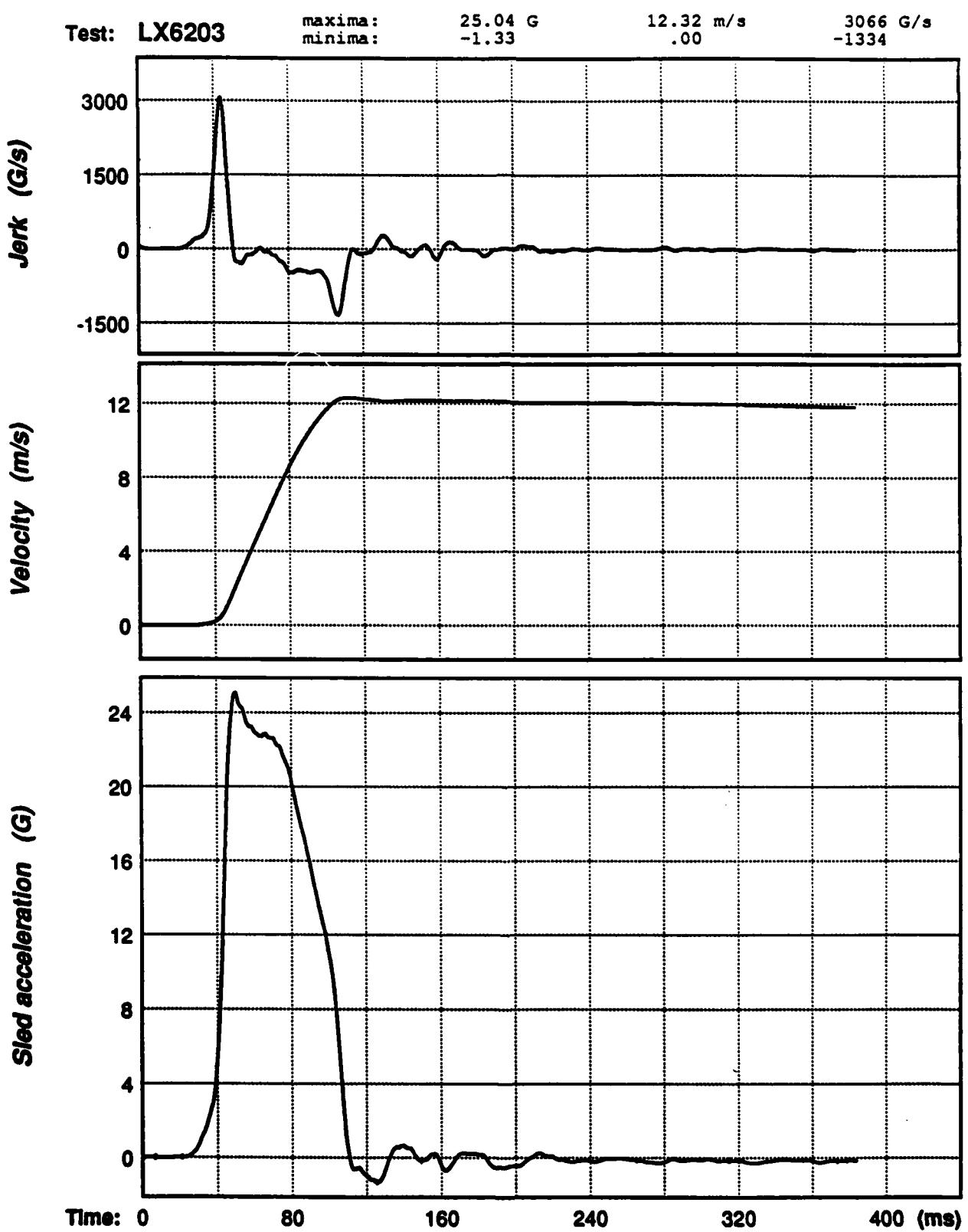


Figure A-7. Sled acceleration signal and its computed velocity and jerk for test LX6203.

Test: LX6204 maxima: 25.03 G 12.33 m/s 3069 G/s
minima: -1.50 .00 -1310

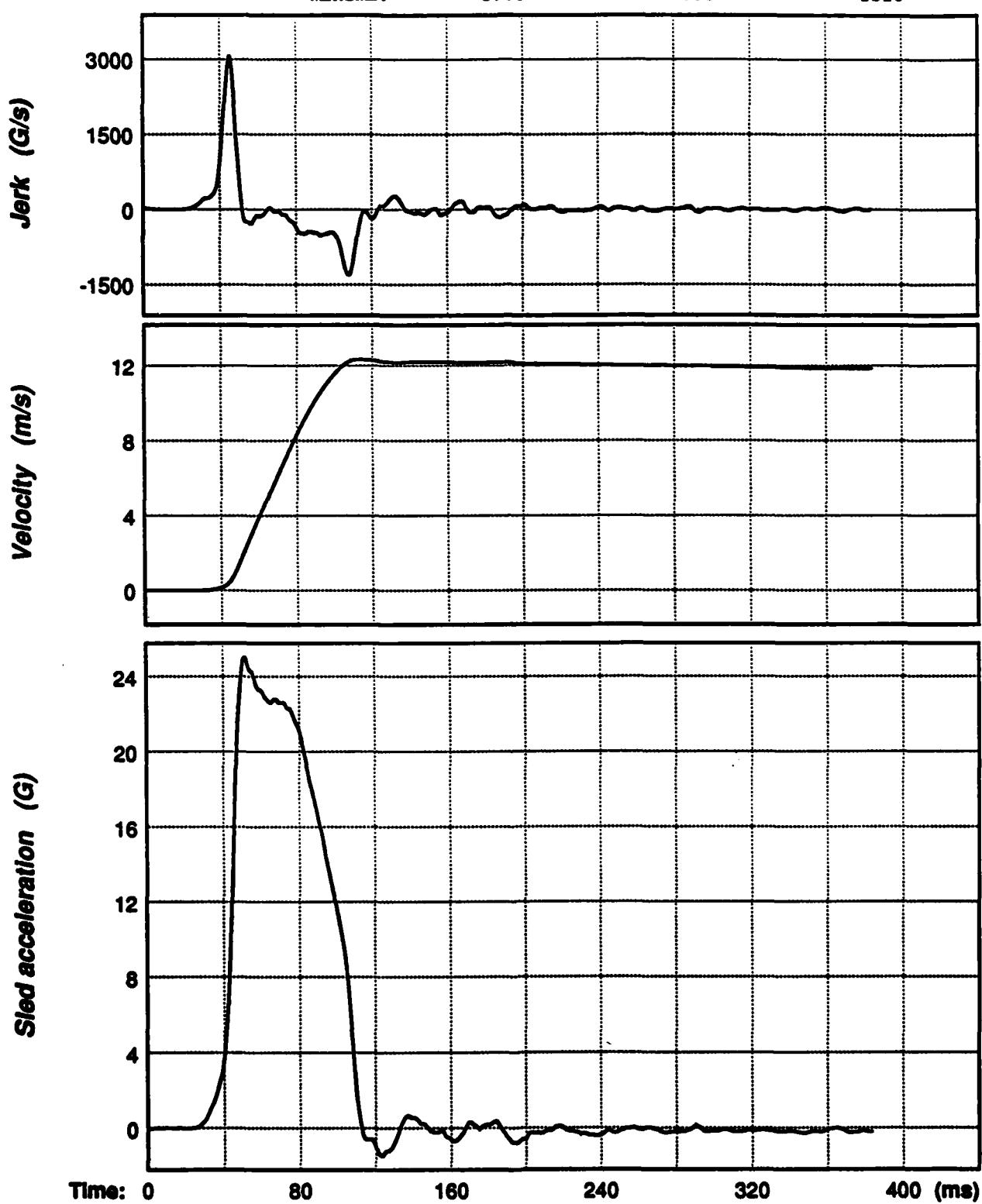


Figure A-8. Sled acceleration signal and its computed velocity and jerk for test LX6204.

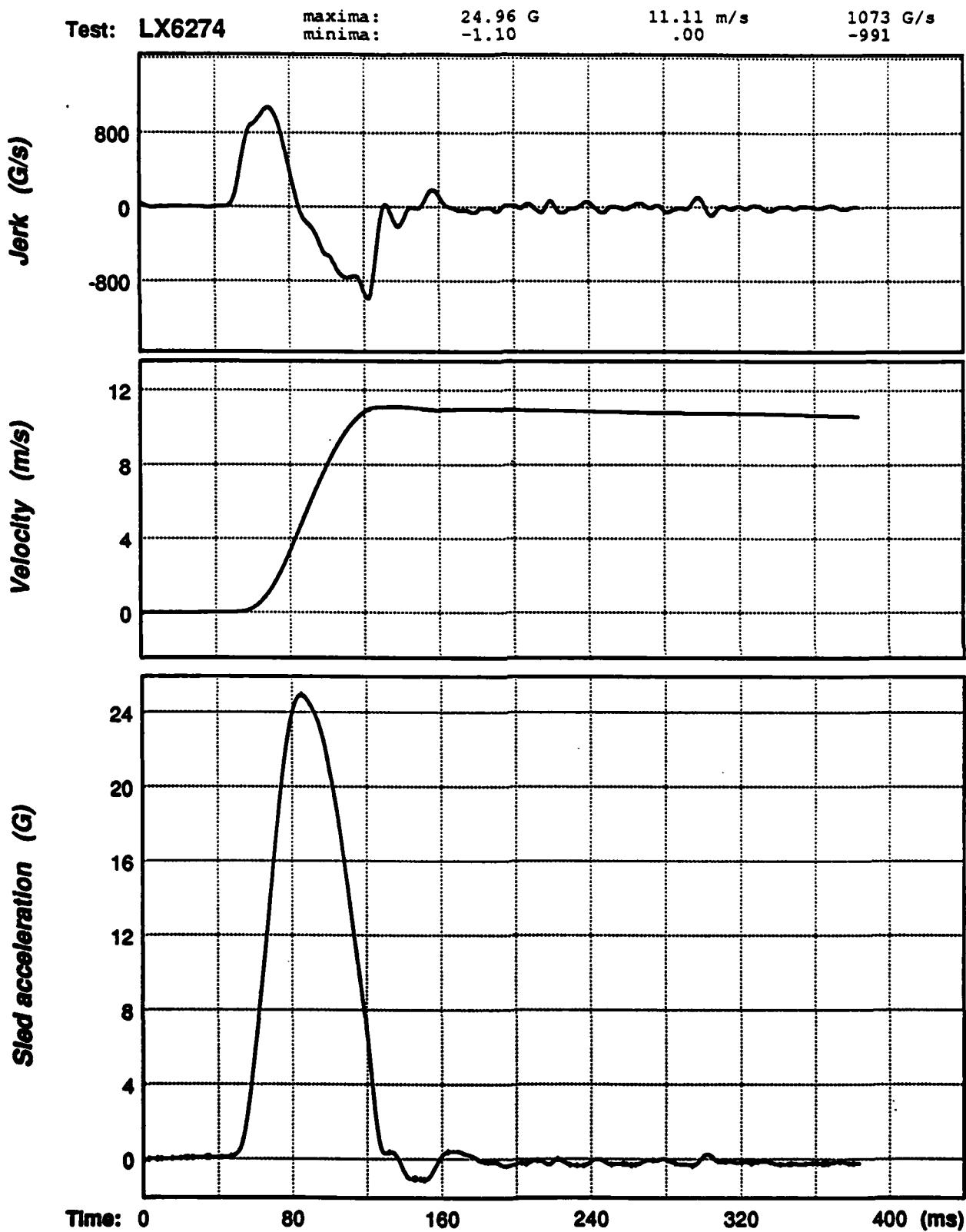


Figure A-9. Sled acceleration signal and its computed velocity and jerk for test LX6274.

Test: LX6275 maxima: 25.01 G 11.12 m/s 1061 G/s
minima: -1.13 .00 -1021

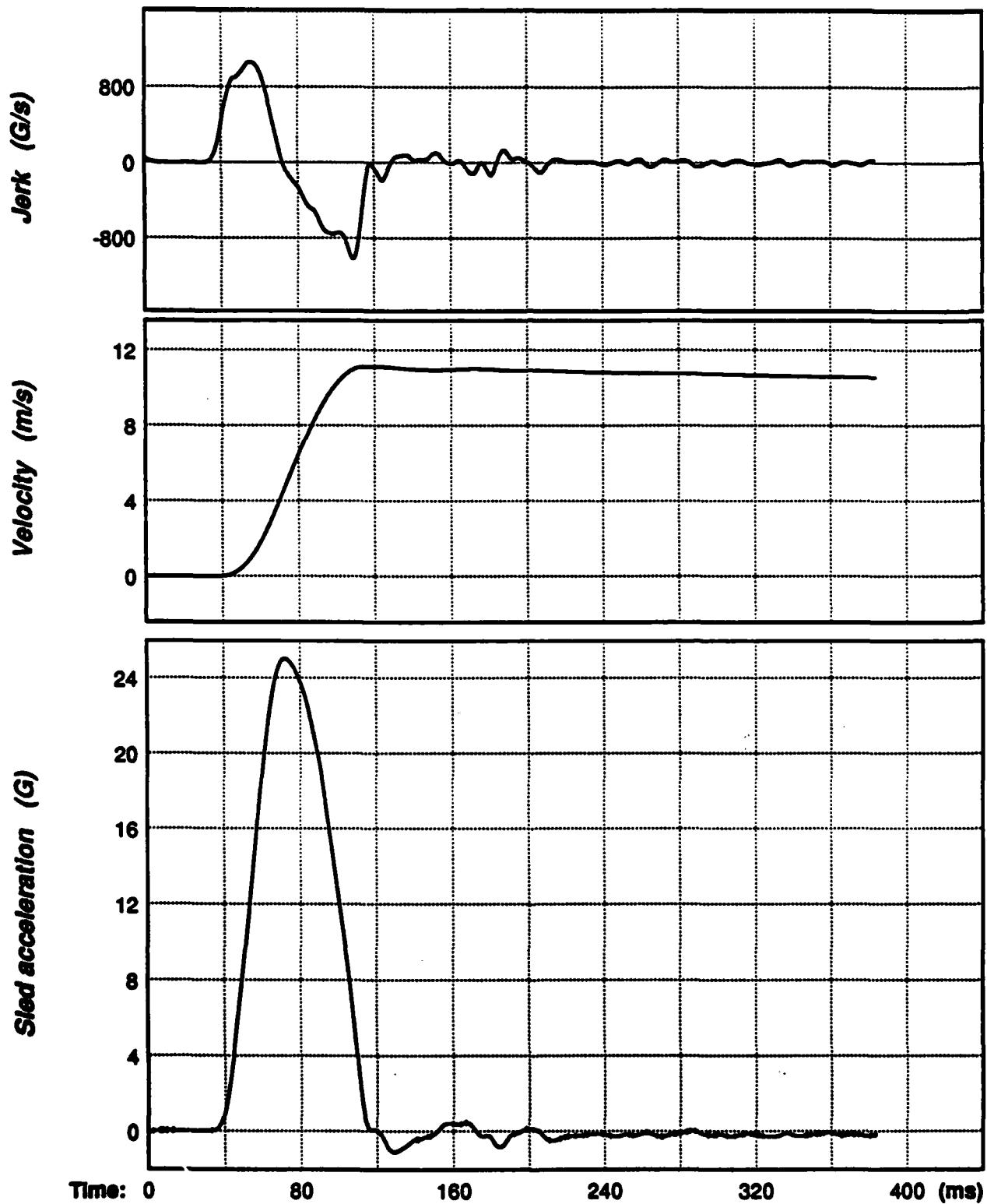


Figure A-10. Sled acceleration signal and its computed velocity and jerk for test LX6275.

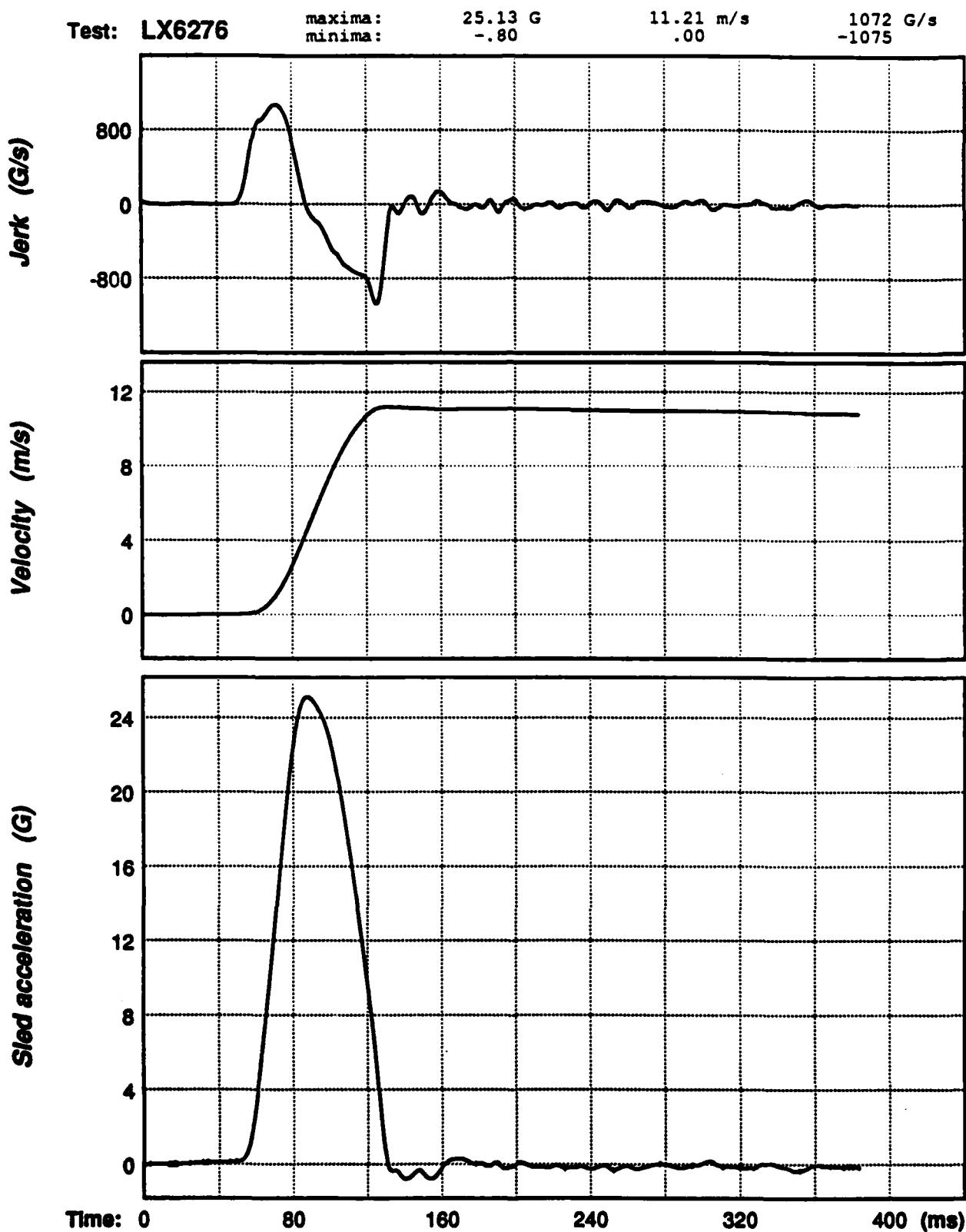


Figure A-11. Sled acceleration signal and its computed velocity and jerk for test LX6276.

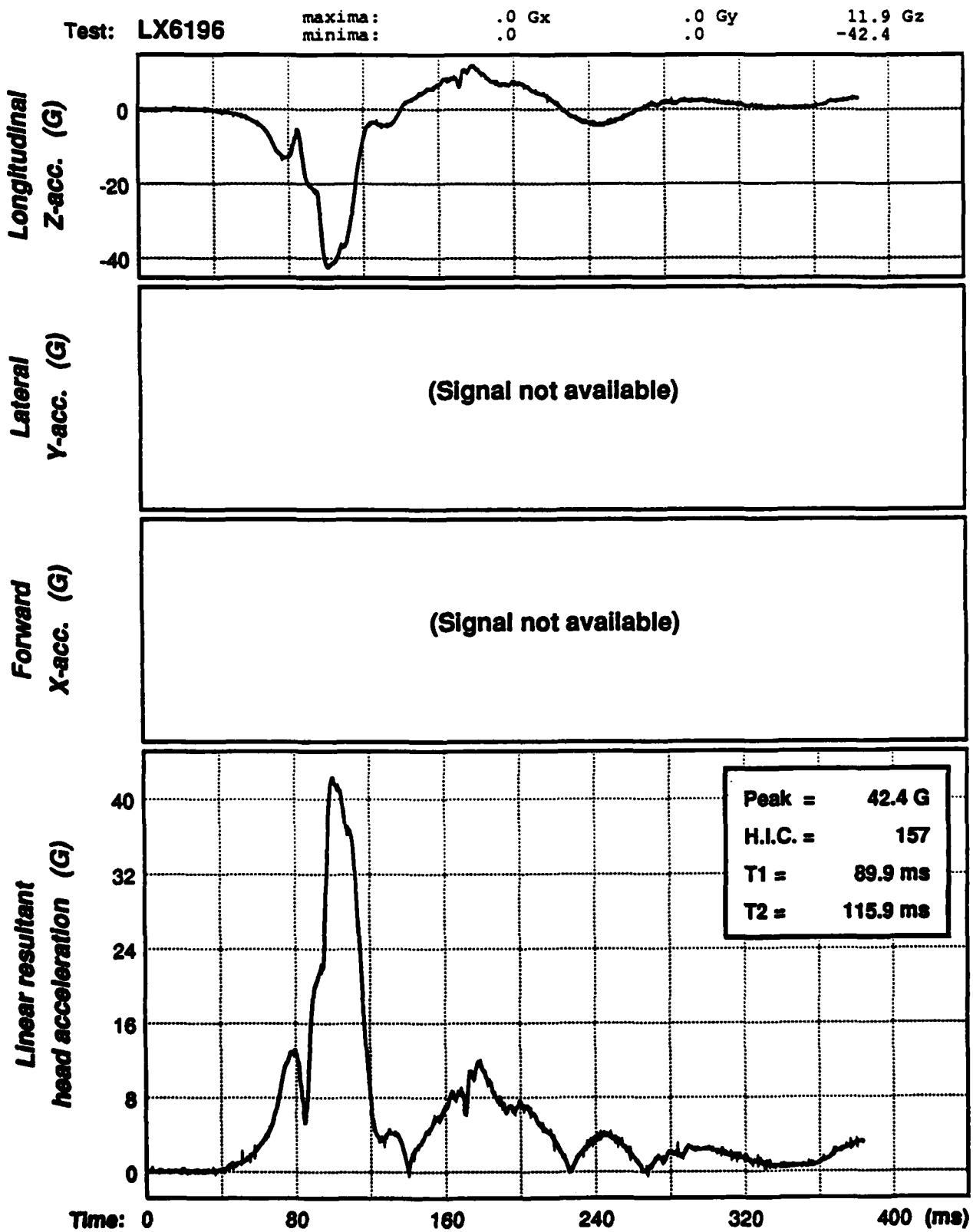


Figure A-12. Three components and resultant of the linear head acceleration for test LX6196.

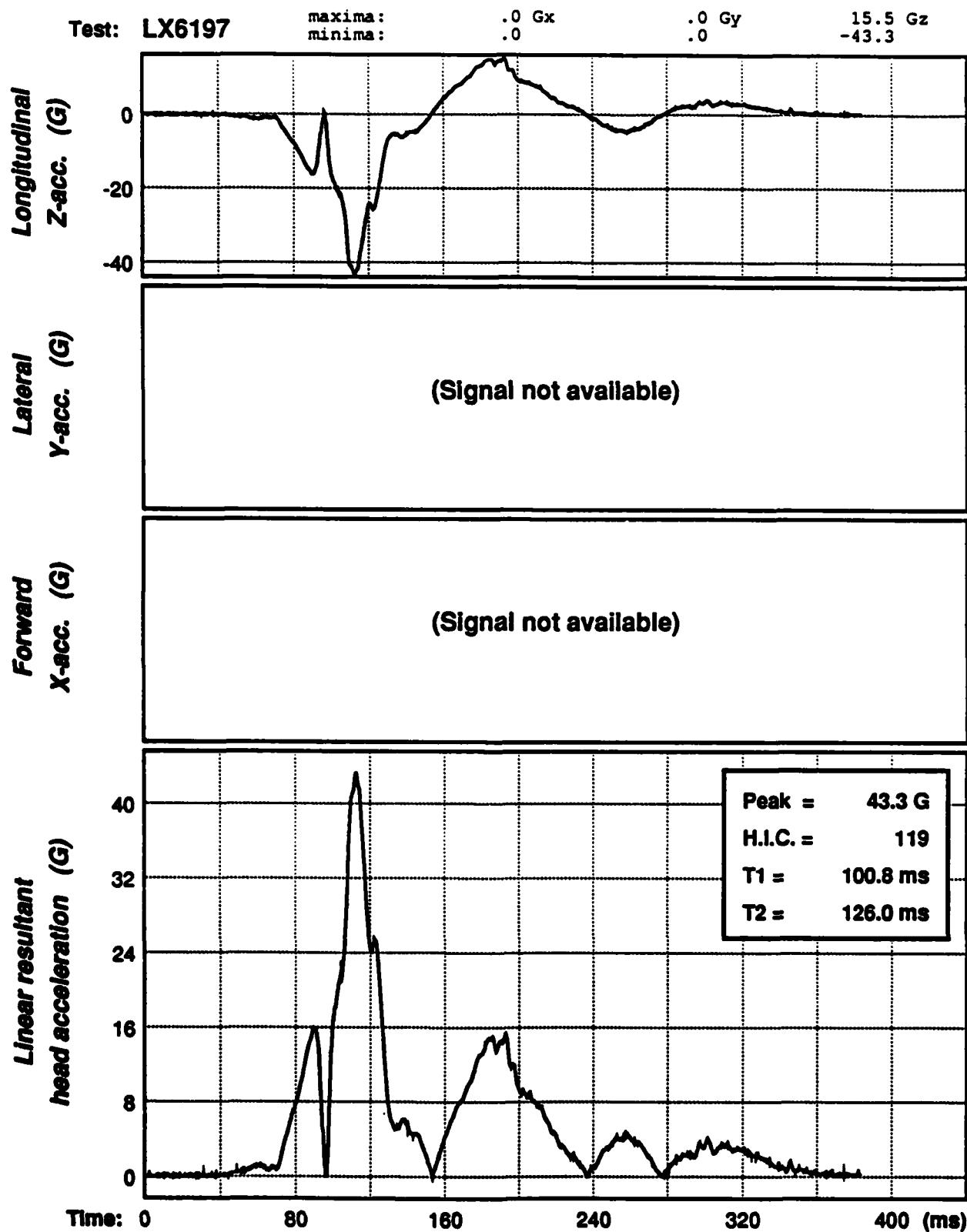


Figure A-13. Three components and resultant of the linear head acceleration for test LX6197.

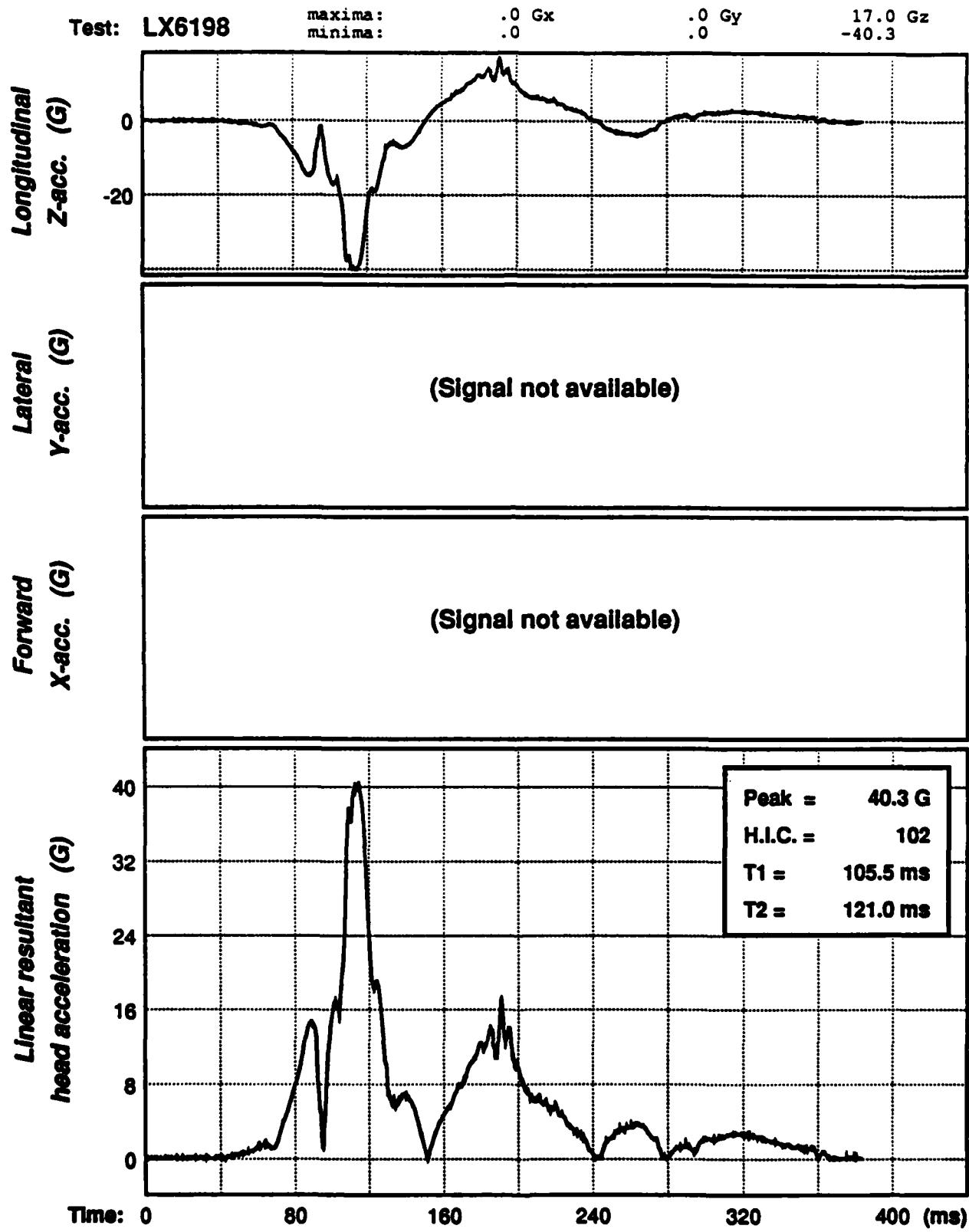


Figure A-14. Three components and resultant of the linear head acceleration for test LX6198.

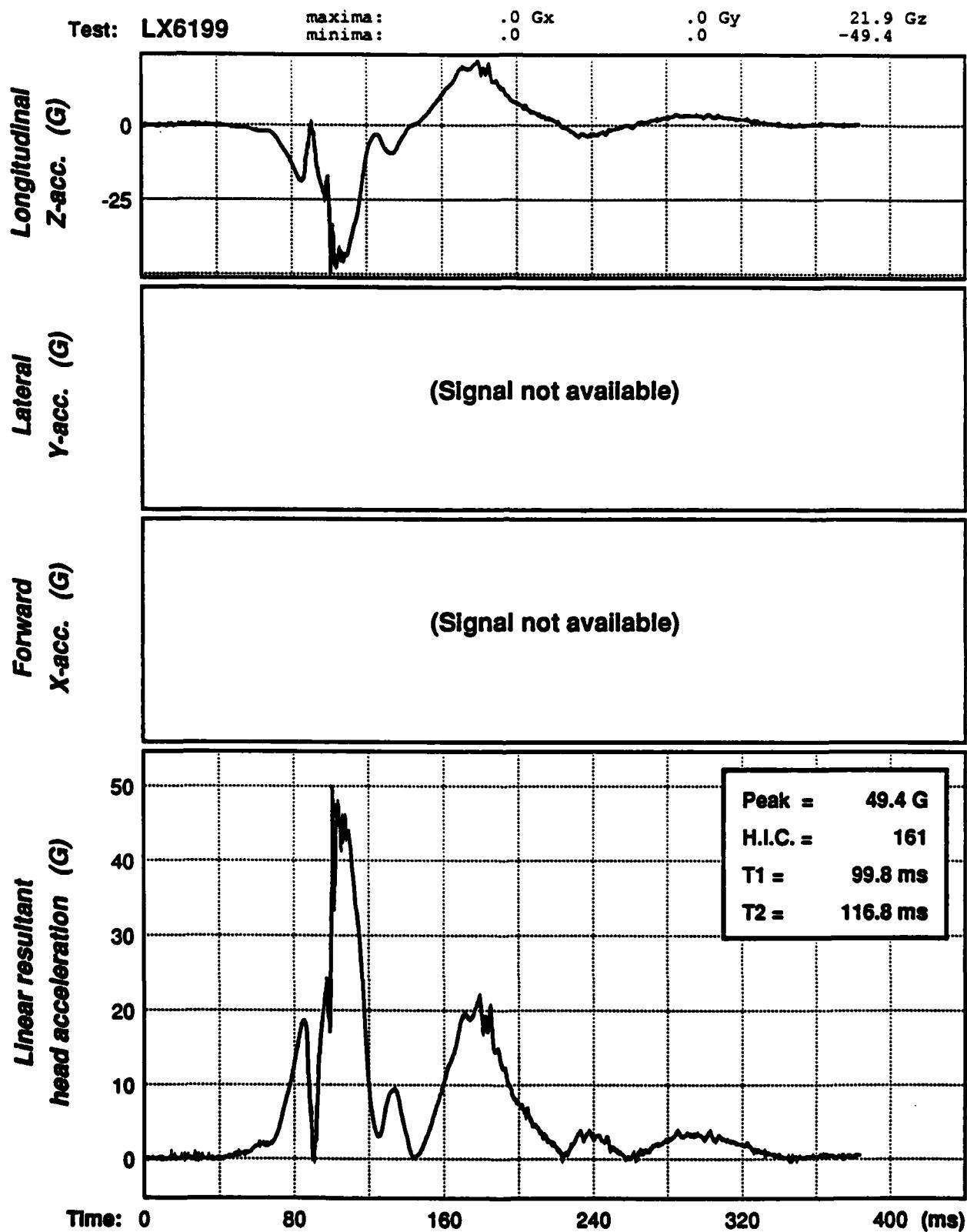


Figure A-15. Three components and resultant of the linear head acceleration for test LX6199.

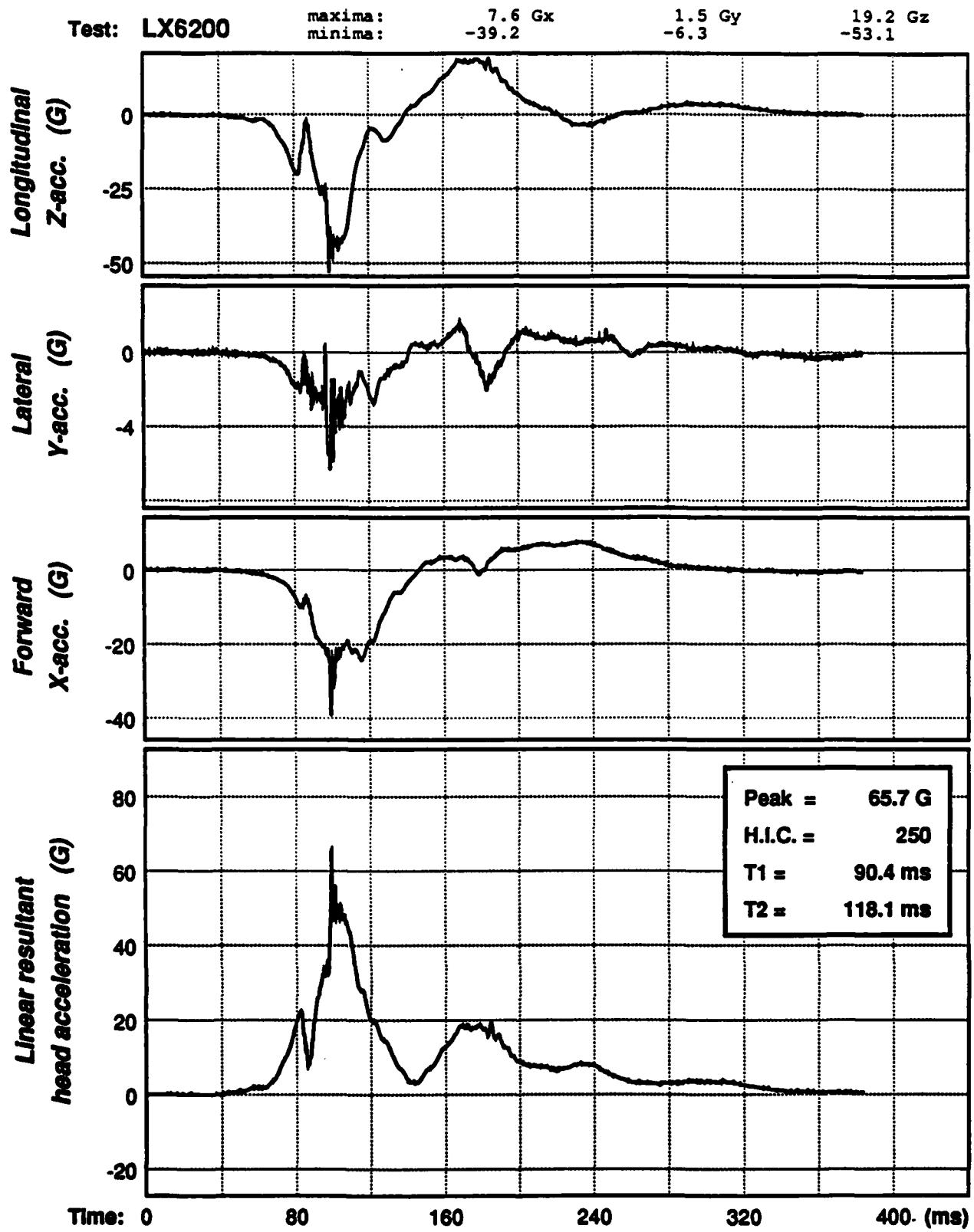


Figure A-16. Three components and resultant of the linear head acceleration for test LX6200.

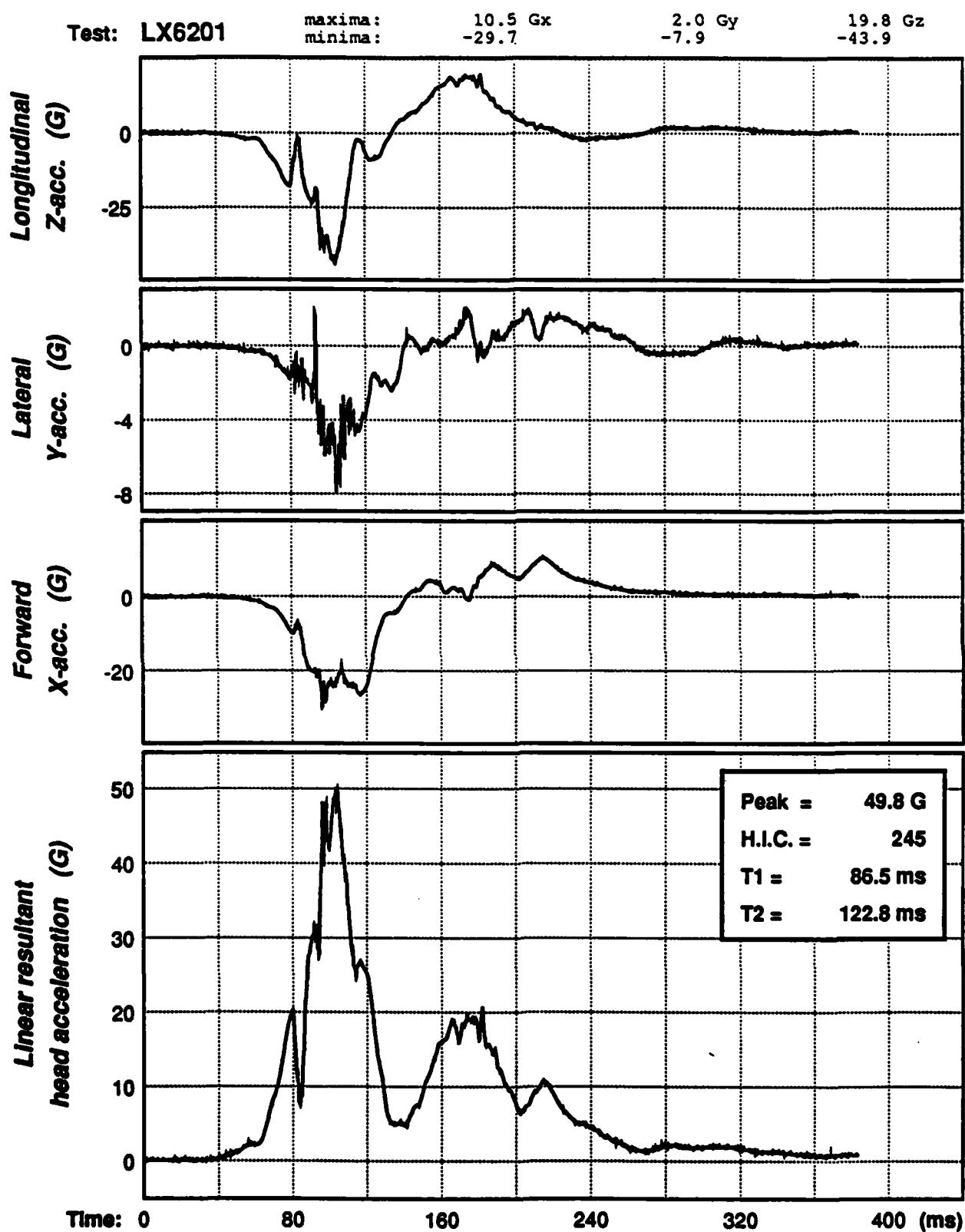


Figure A-17. Three components and resultant of the linear head acceleration for test LX6201.

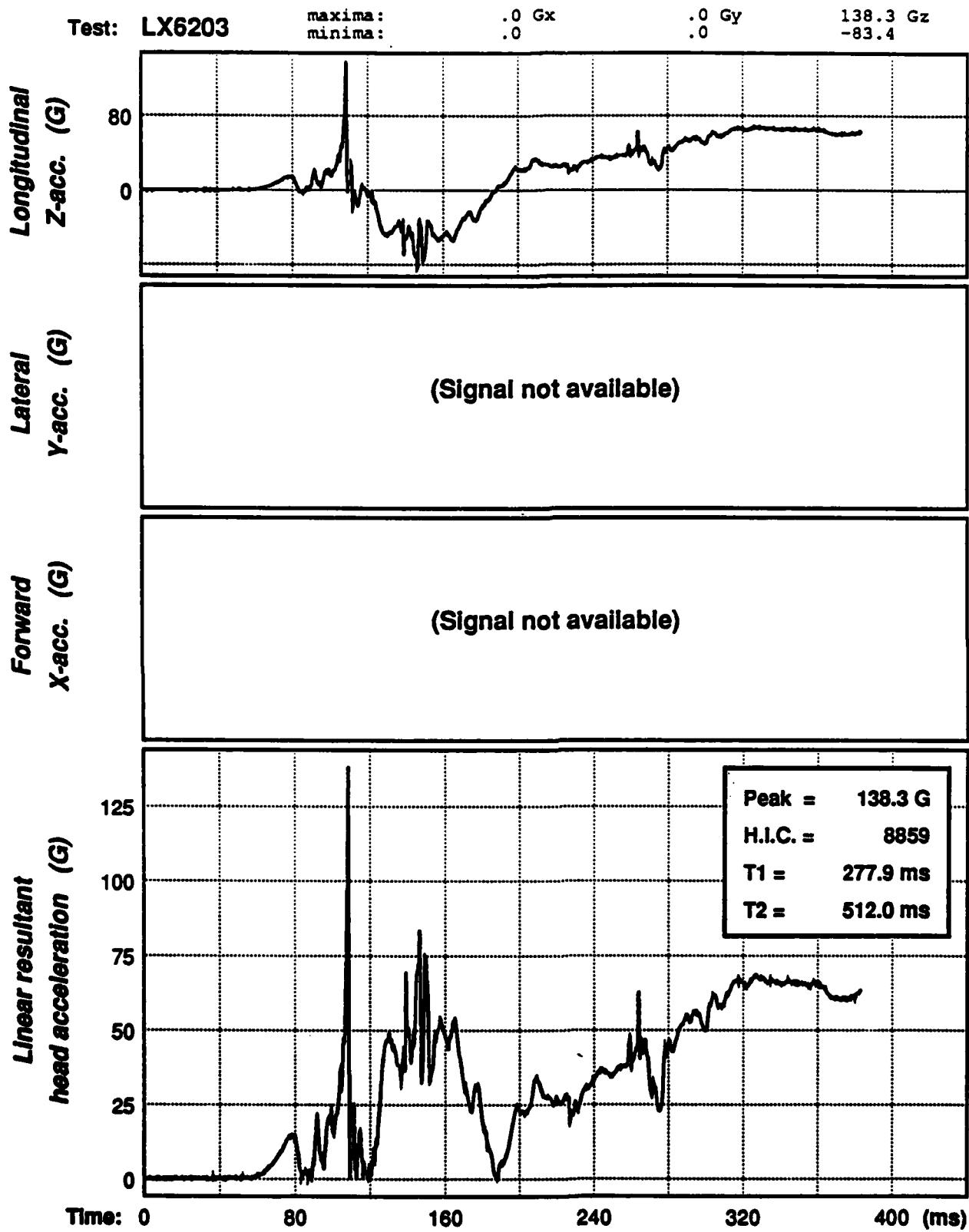


Figure A-18. Three components and resultant of the linear head acceleration for test LX6203.

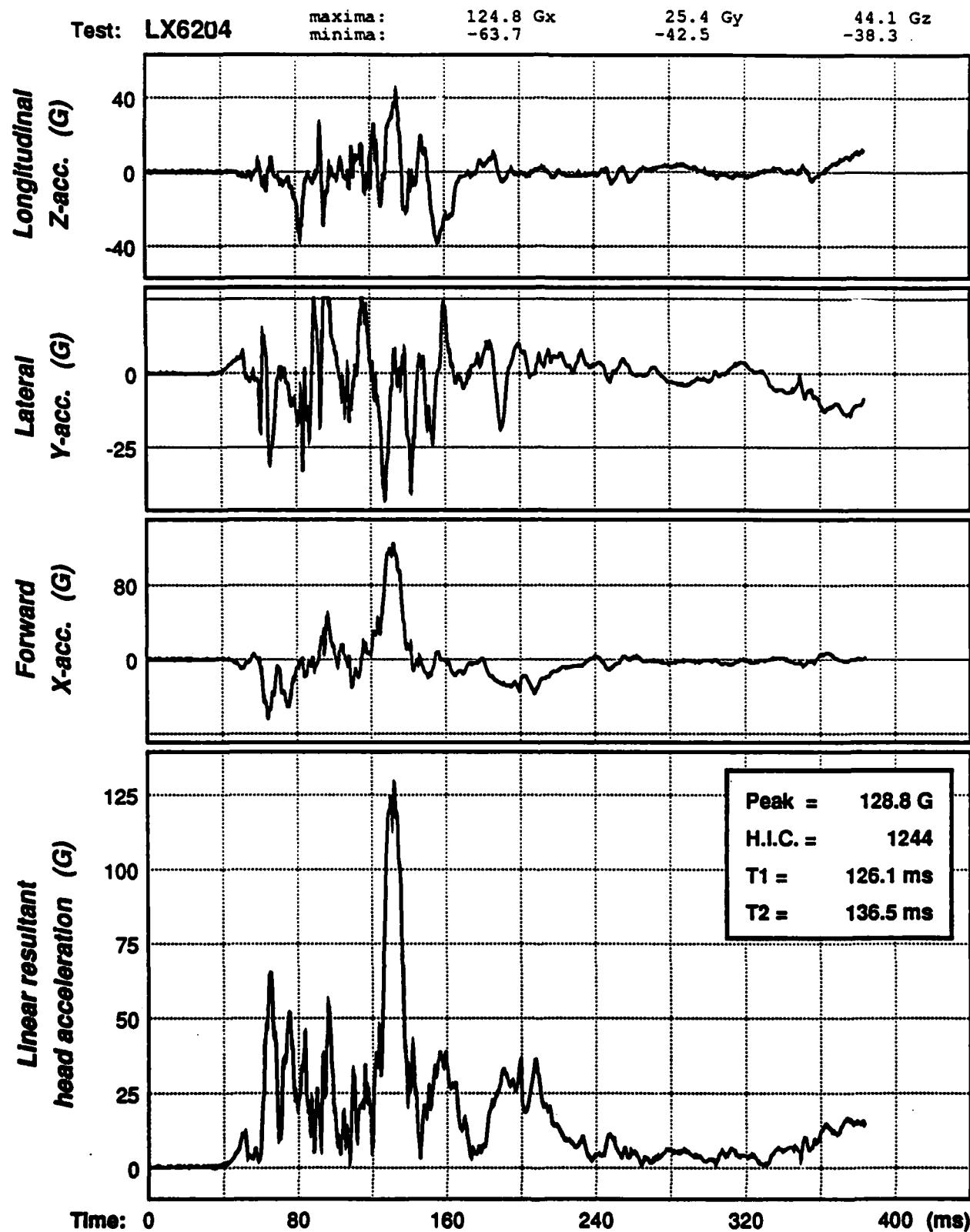


Figure A-19. Three components and resultant of the linear head acceleration for test LX6204.

Test: LX6274

maxima:
minima:

42.4 Gx
-78.4

10.3 Gy
-6.8

44.9 Gz
-37.5

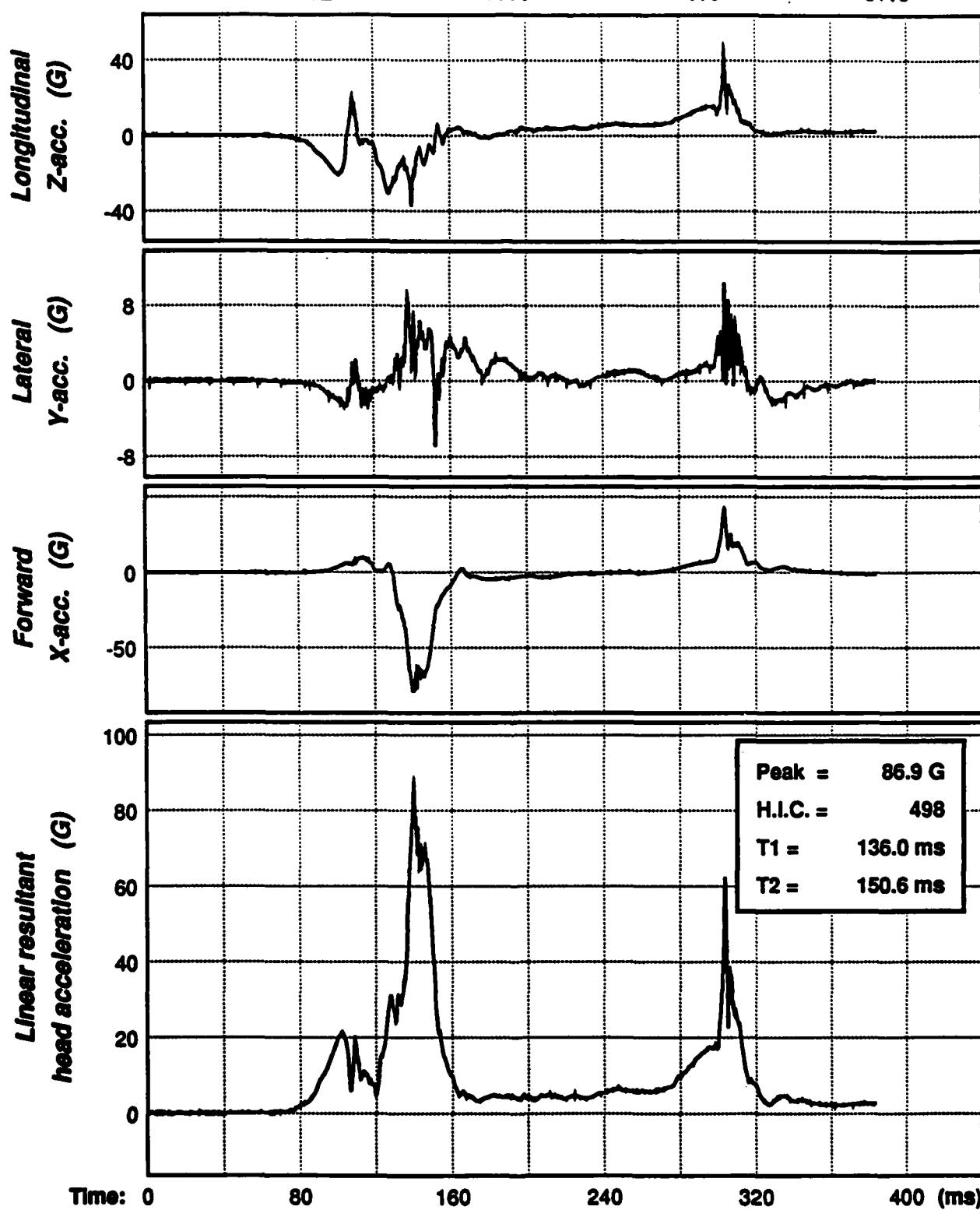


Figure A-20. Three components and resultant of the linear head acceleration for test LX6274.

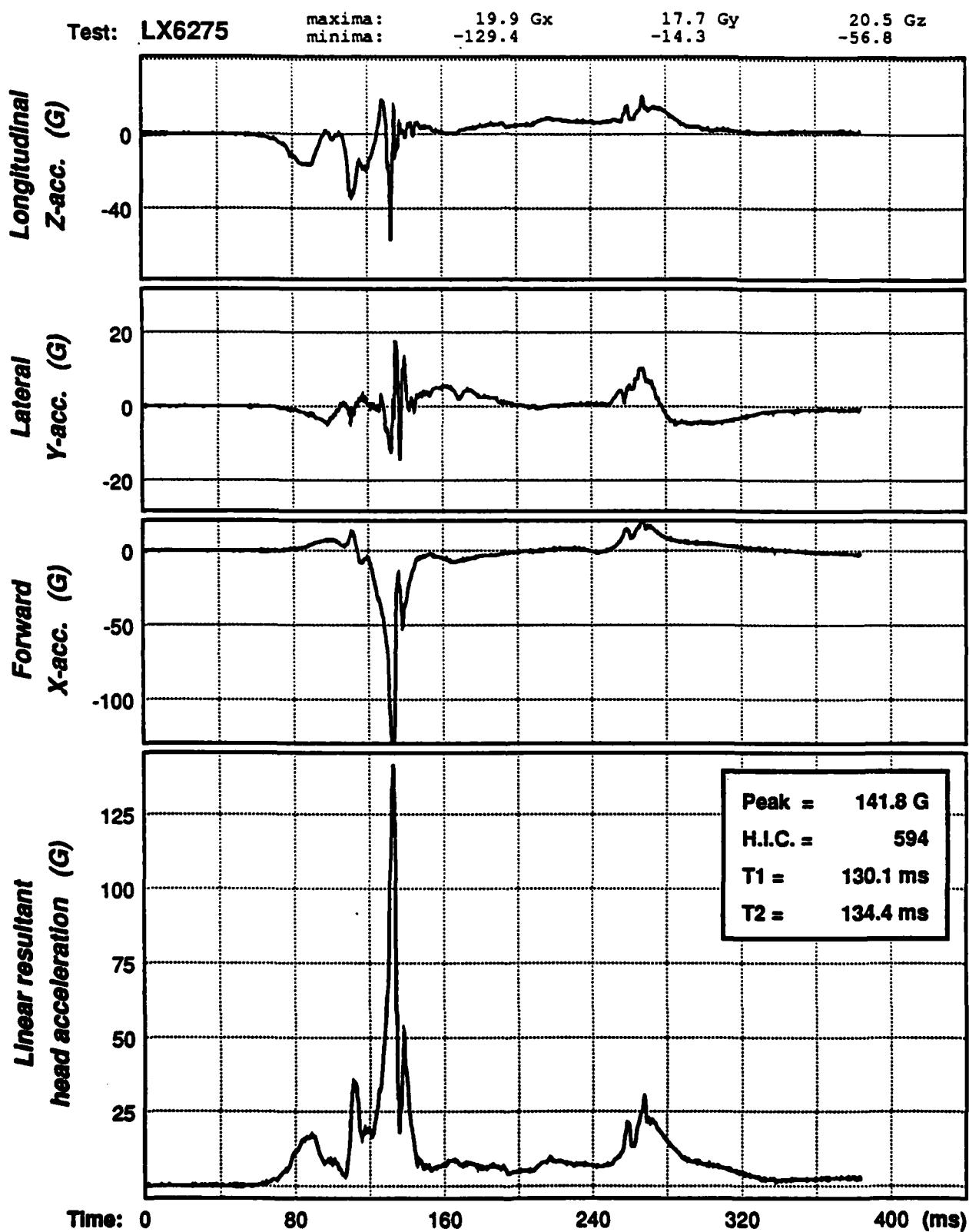


Figure A-21. Three components and resultant of the linear head acceleration for test LX6275.

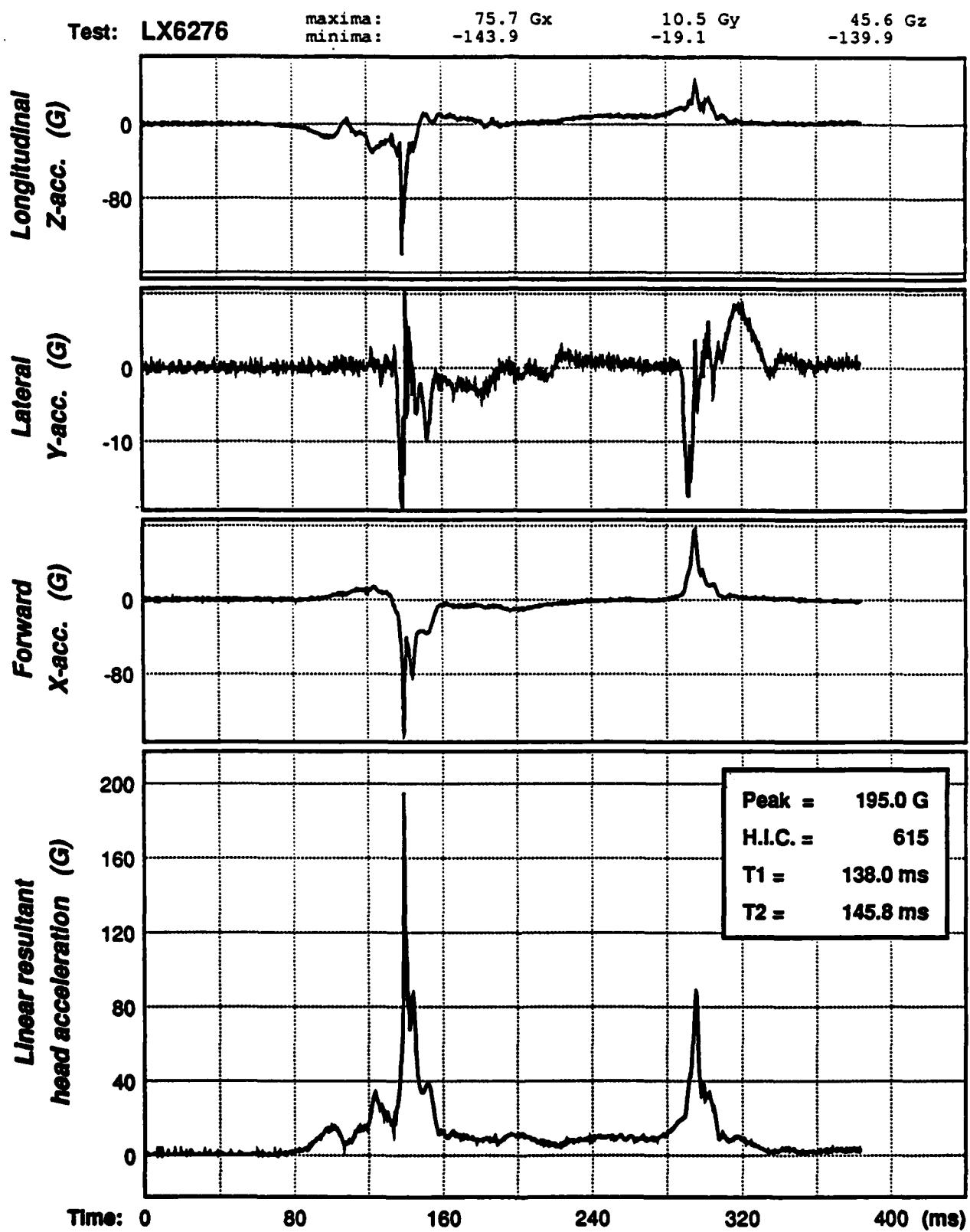


Figure A-22. Three components and resultant of the linear head acceleration for test LX6276.

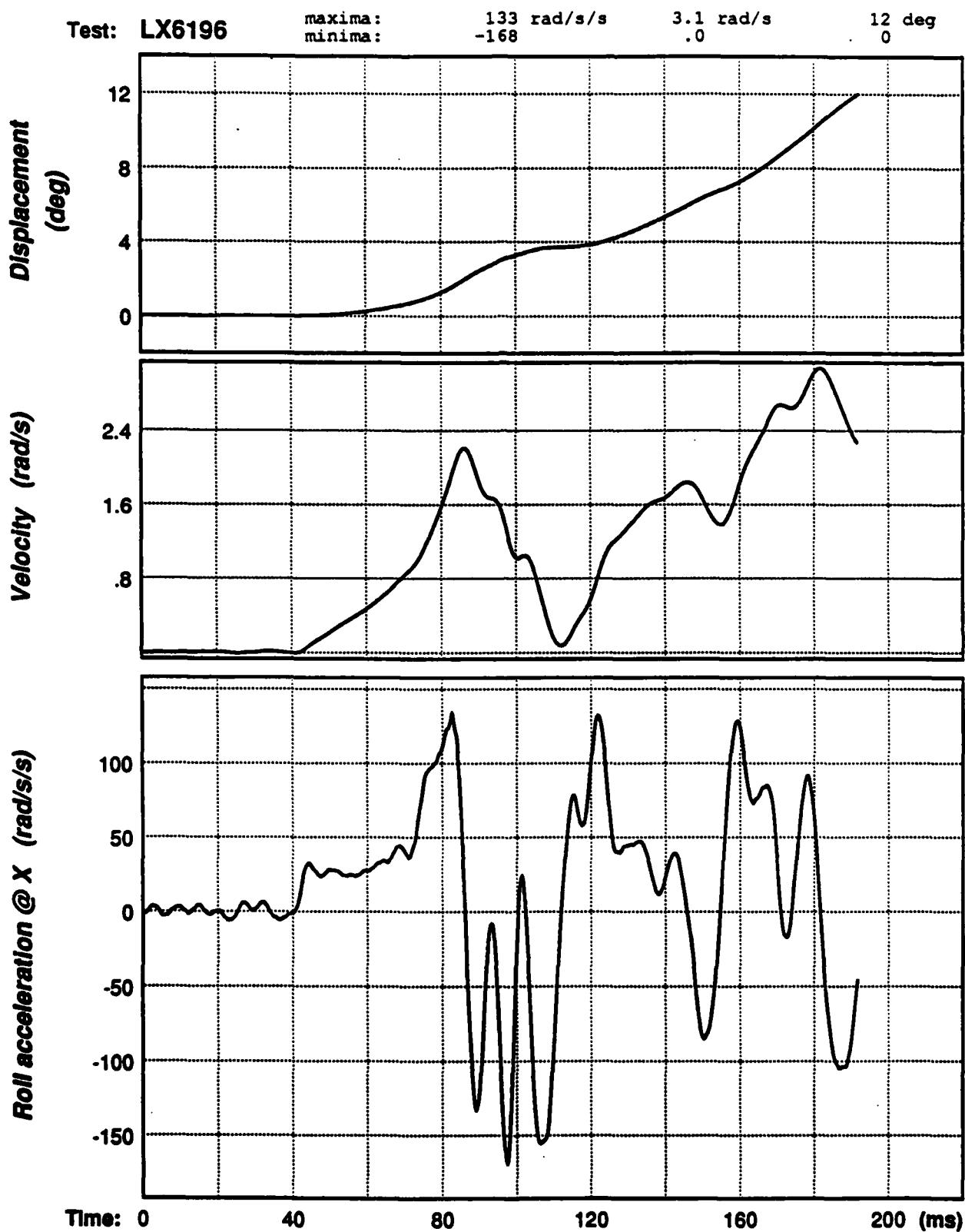


Figure A-23. Head roll angular acceleration, velocity, and displacement signals for test LX6196.

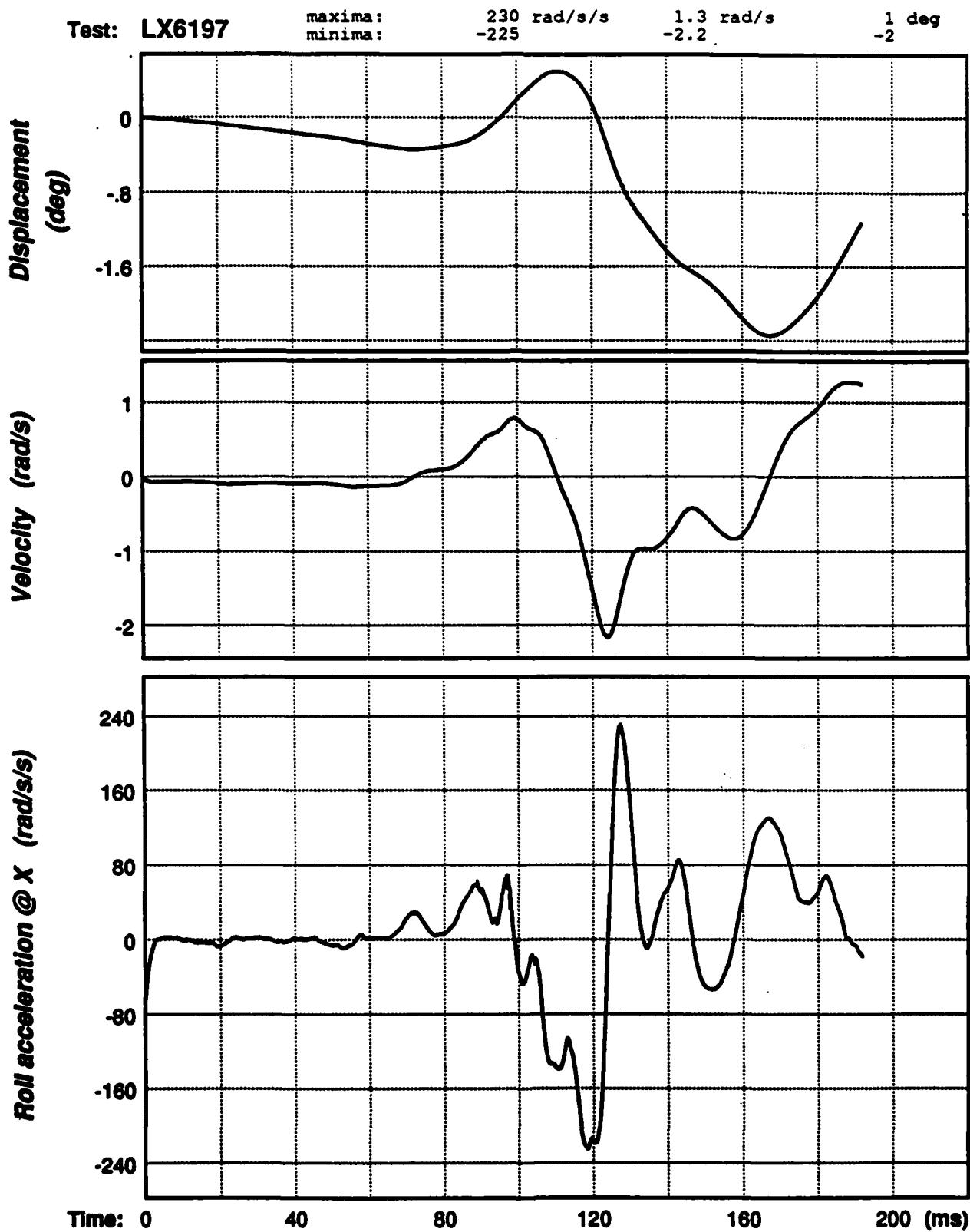


Figure A-24. Head roll angular acceleration, velocity, and displacement signals for test LX6197.

Test: LX6198 maxima: 180 rad/s/s 1.5 rad/s 2 deg
minima: -327 -1.6 0

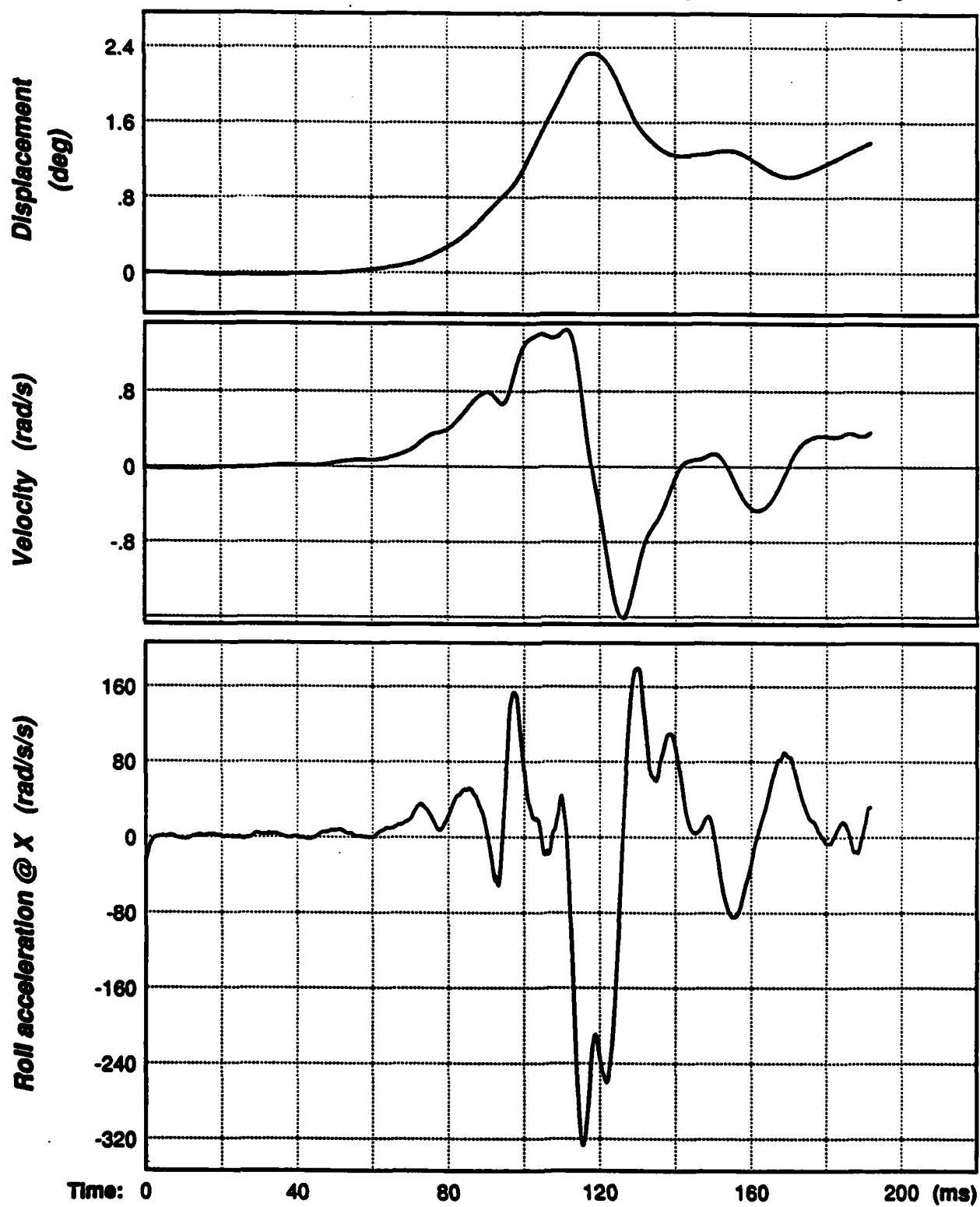


Figure A-25. Head roll angular acceleration, velocity, and displacement signals for test LX6198.

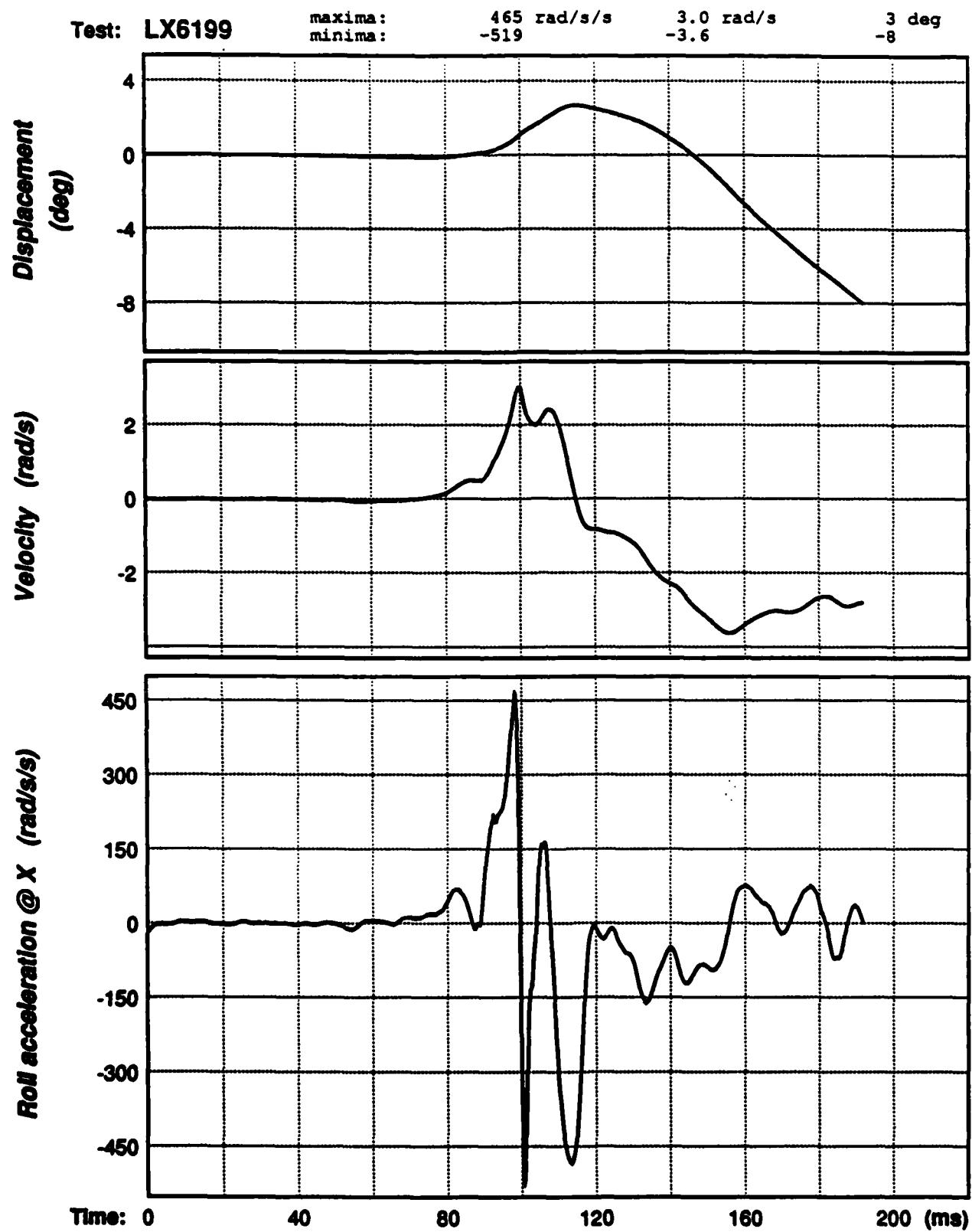


Figure A-26. Head roll angular acceleration, velocity, and displacement signals for test LX6199.

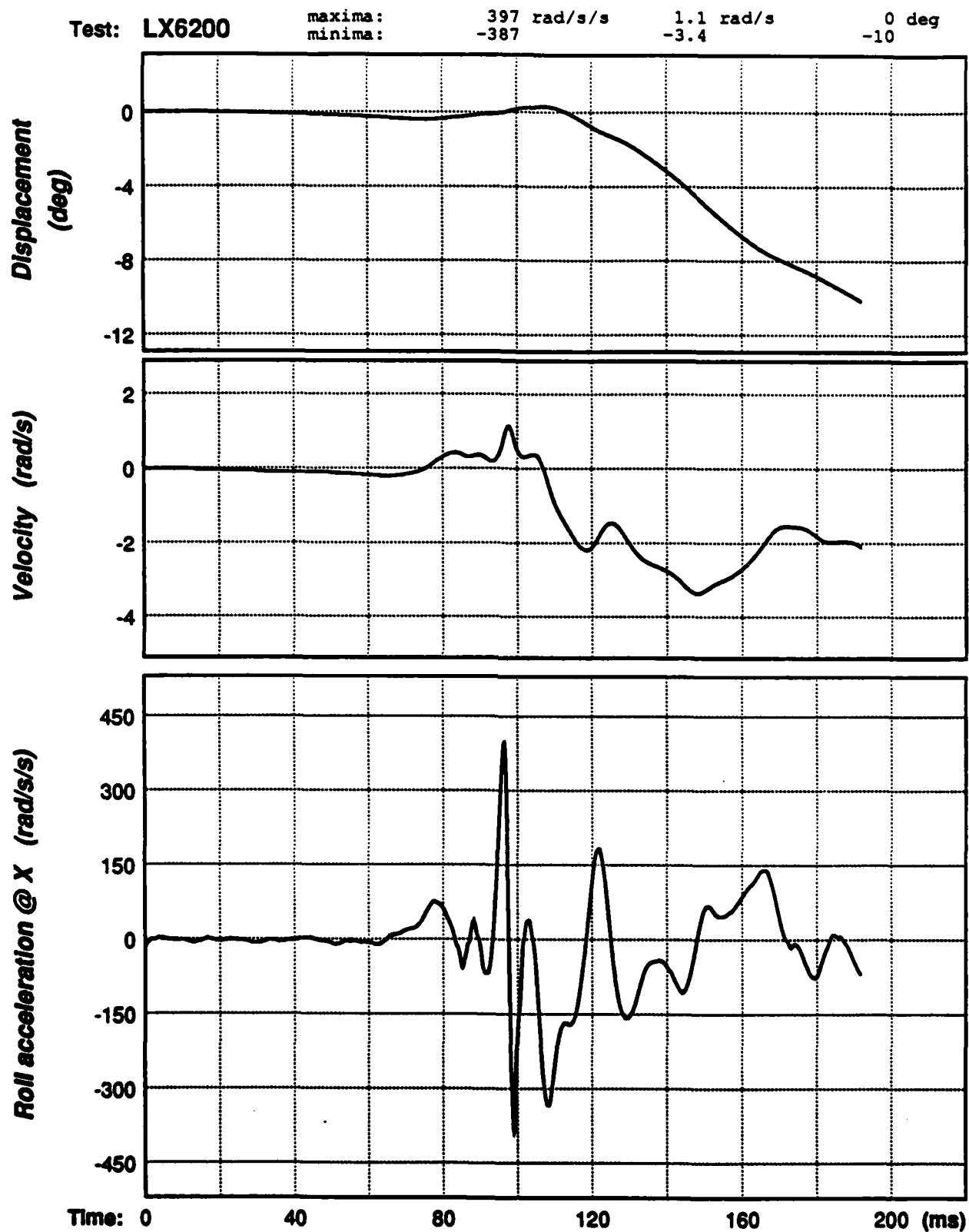


Figure A-27. Head roll angular acceleration, velocity, and displacement signals for test LX6200.

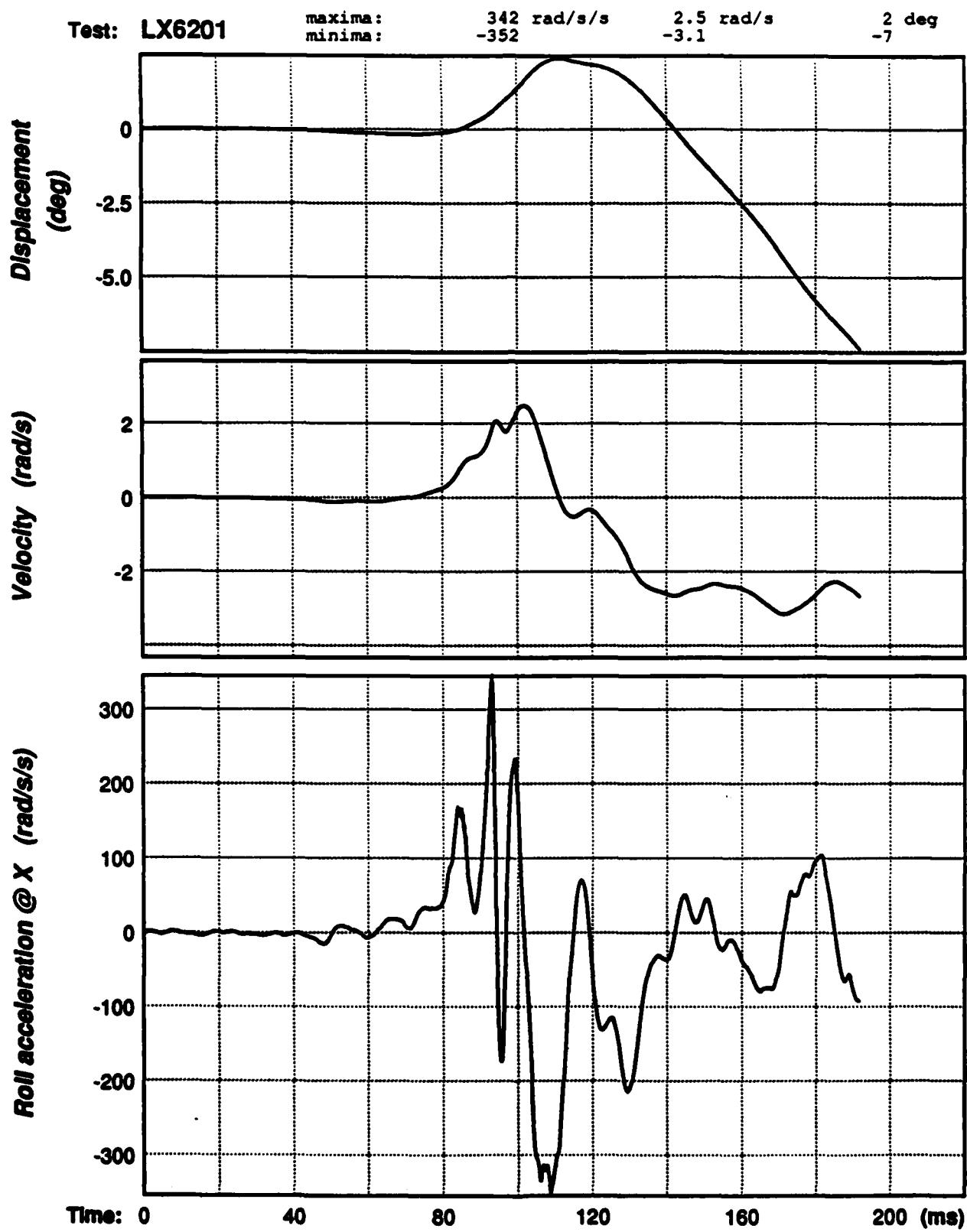


Figure A-28. Head roll angular acceleration, velocity, and displacement signals for test LX6201.

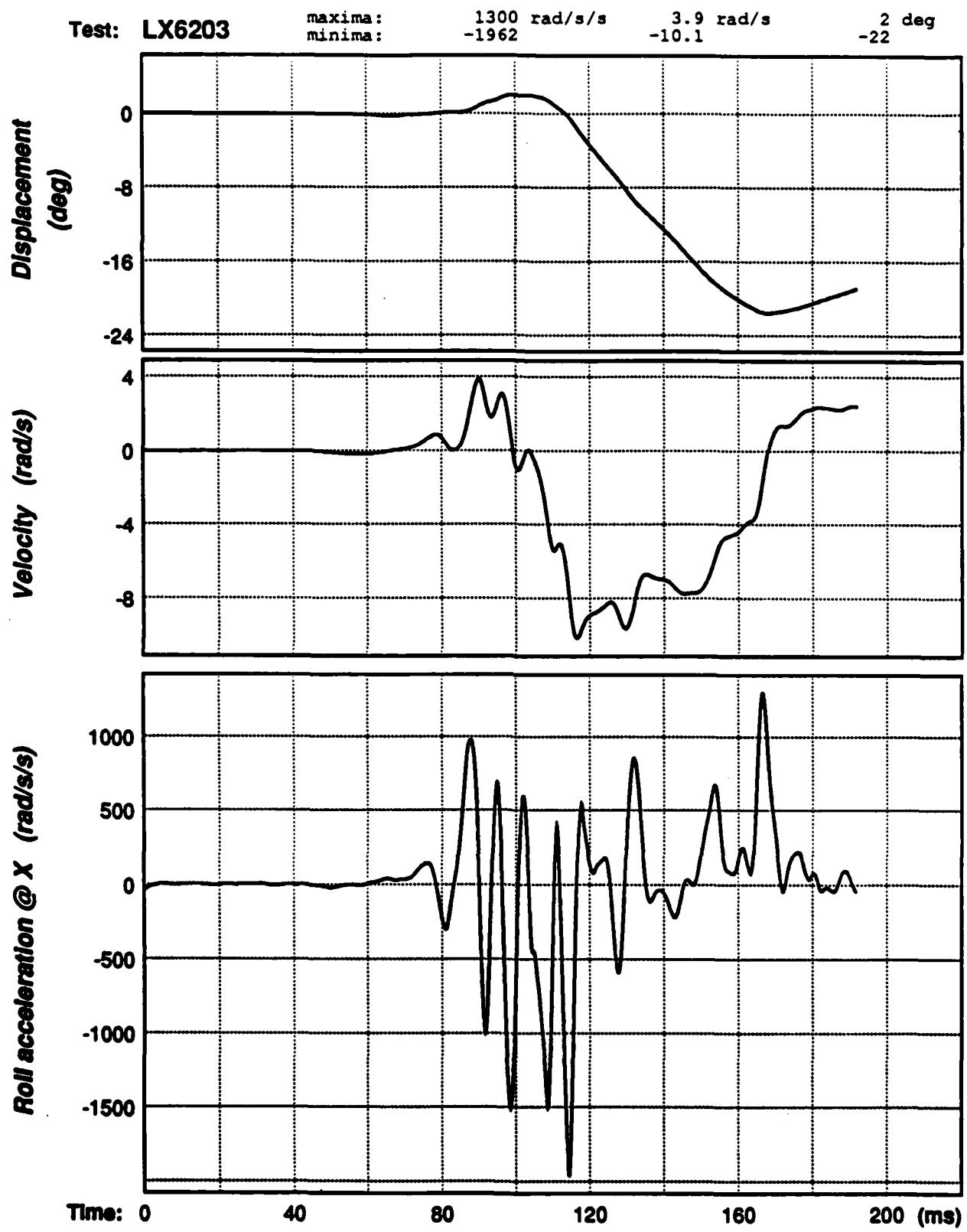
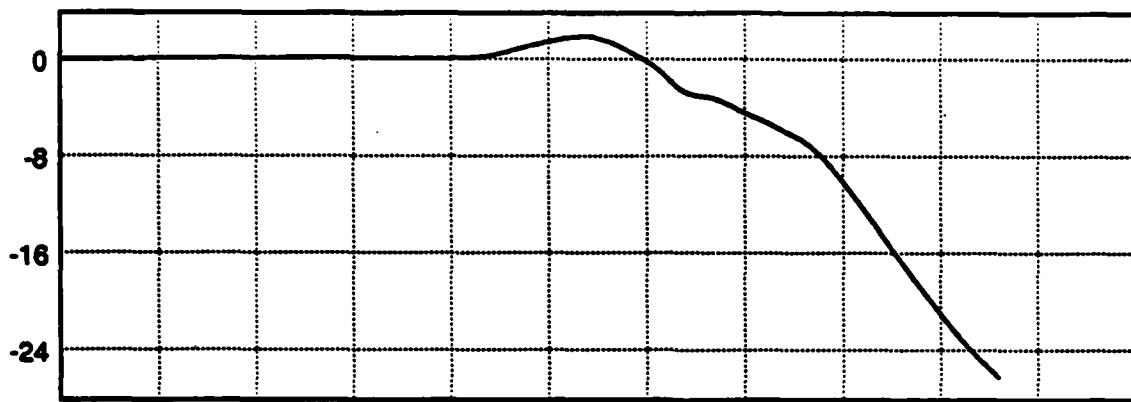


Figure A-29. Head roll angular acceleration, velocity, and displacement signals for test LX6203.

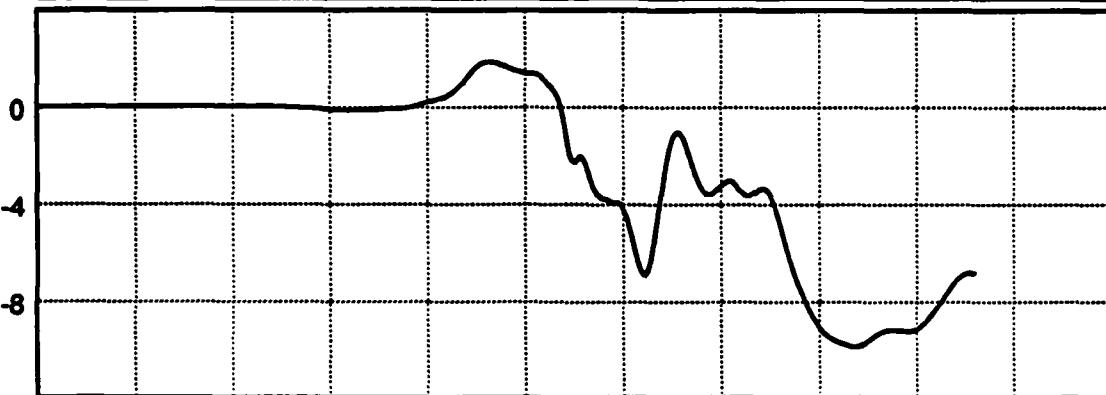
Test: LX6204

maxima: 1347 rad/s/s
minima: -1341 -9.8 -26

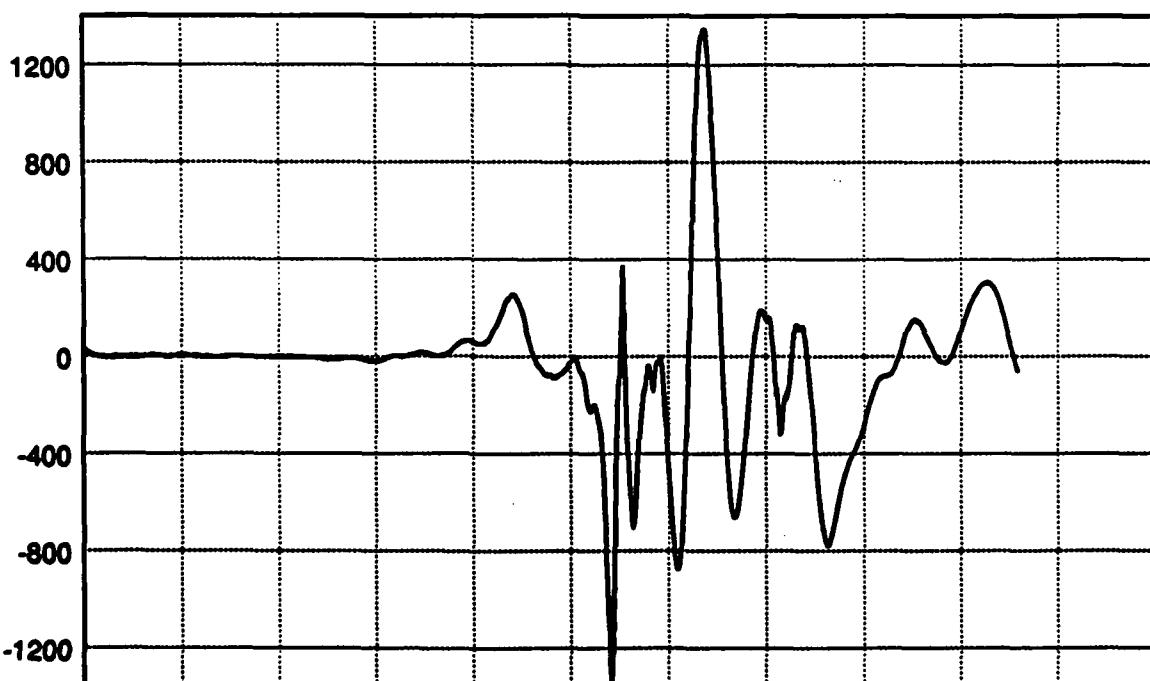
Displacement
(deg)



Velocity (rad/s)



Roll acceleration @ X (rad/s/s)



Time: 0 40 80 120 160 200 (ms)

Figure A-30. Head roll angular acceleration, velocity, and displacement signals for test LX6204.

Test: LX6274

maxima:
minima:

780 rad/s/s
-506

4.7 rad/s
-5.1

5 deg
-1

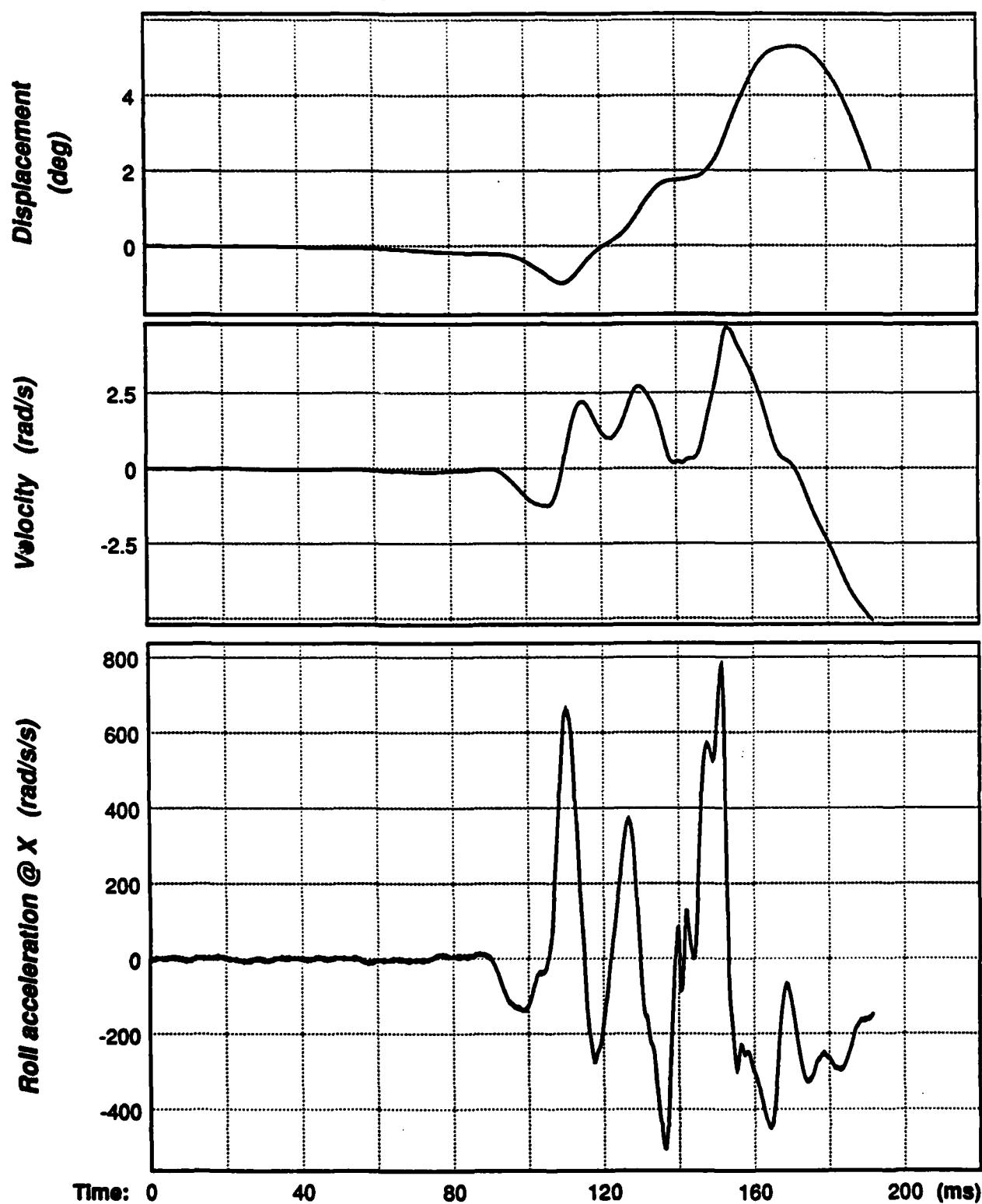


Figure A-31. Head roll angular acceleration, velocity, and displacement signals for test LX6274.

Test: LX6275 maxima: 2572 rad/s/s 8.2 rad/s 10 deg
 minima: -1509 -9.3 -2

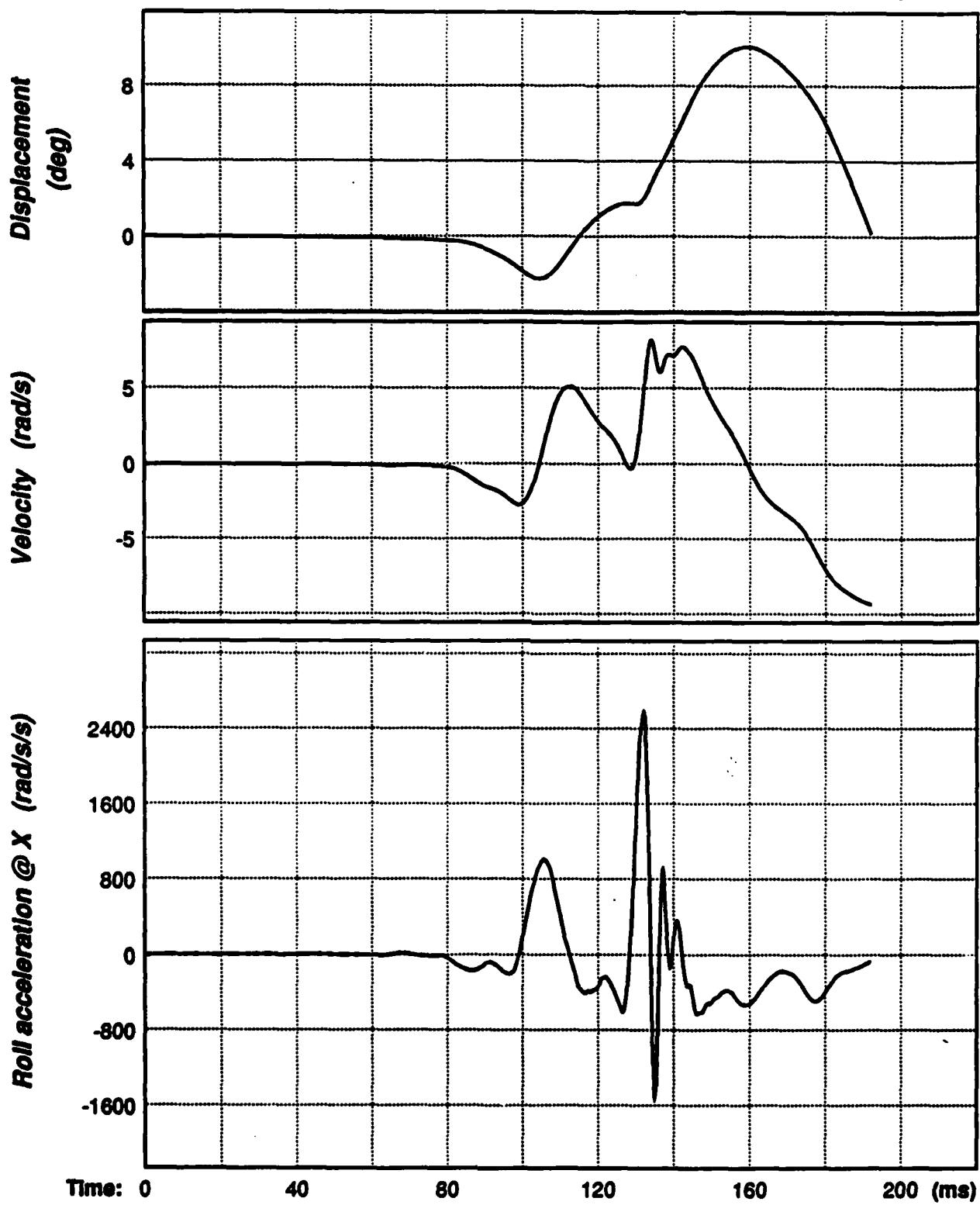


Figure A-32. Head roll angular acceleration, velocity, and displacement signals for test LX6275.

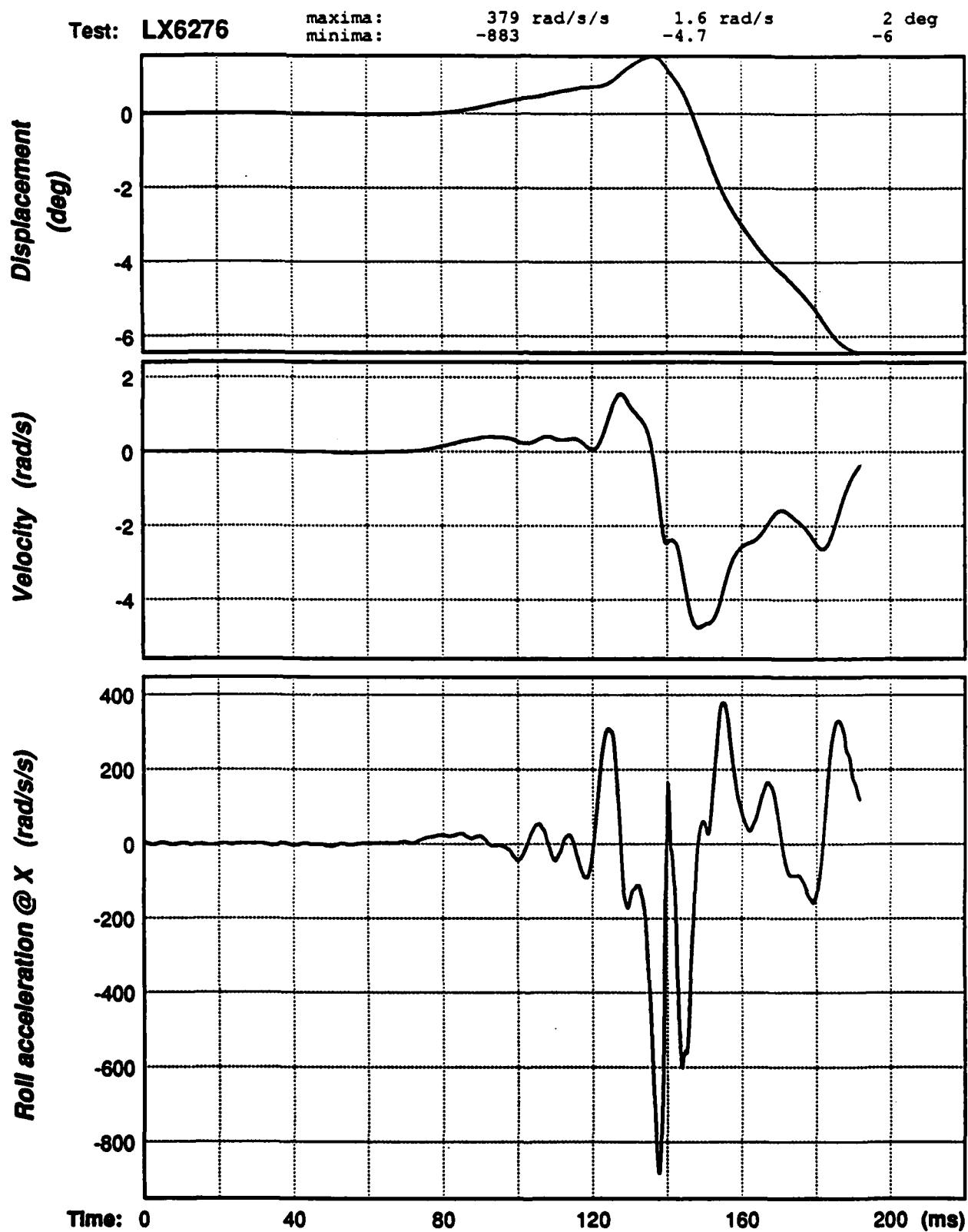


Figure A-33. Head roll angular acceleration, velocity, and displacement signals for test LX6276.

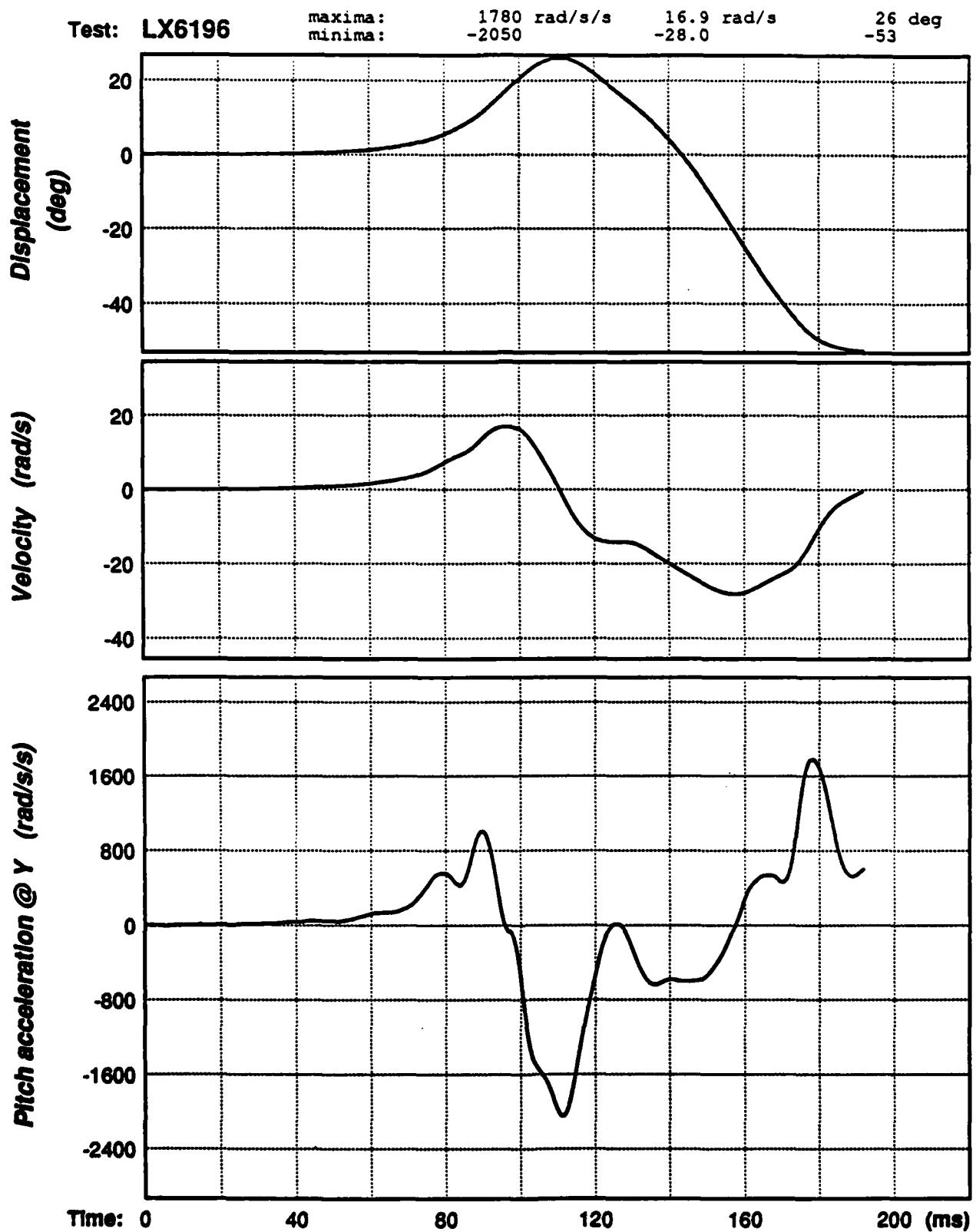


Figure A-34. Head pitch angular acceleration, velocity, and displacement signals for test LX6196.

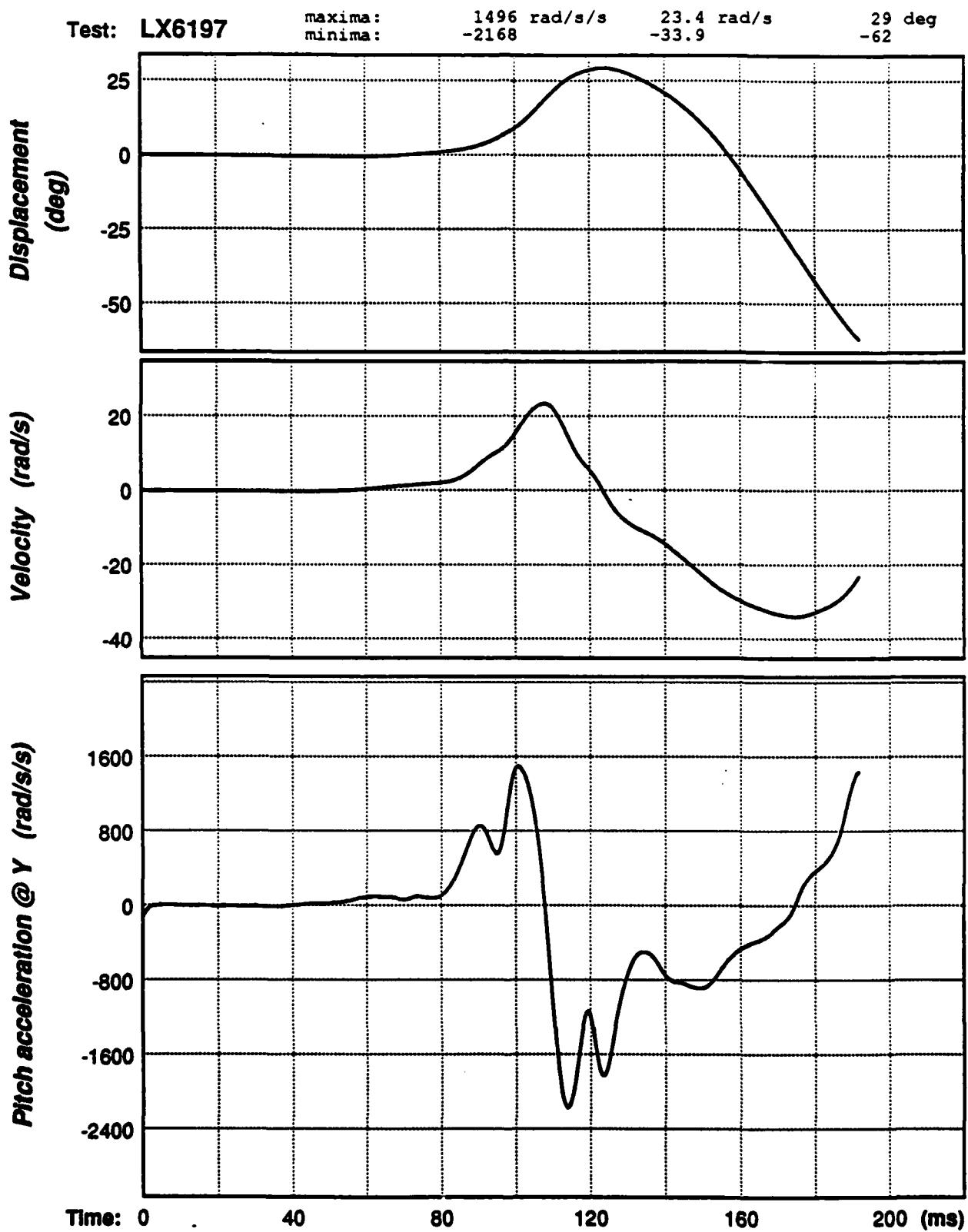


Figure A-35. Head pitch angular acceleration, velocity, and displacement signals for test LX6197.

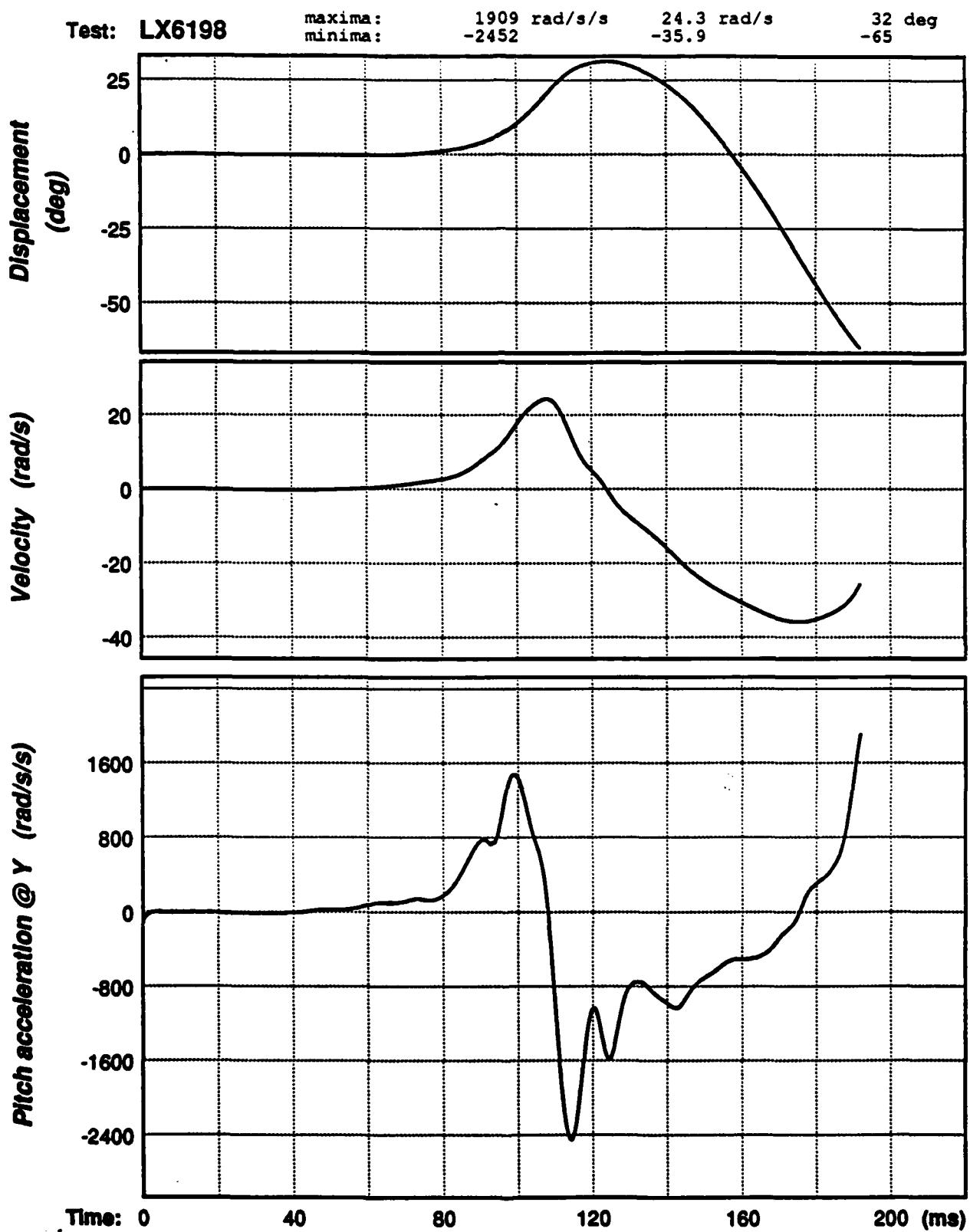


Figure A-36. Head pitch angular acceleration, velocity, and displacement signals for test LX6198.

Test: LX6199 maxima: 2666 rad/s/s 31.0 rad/s 39 deg
minima: -2868 -40.8 -71

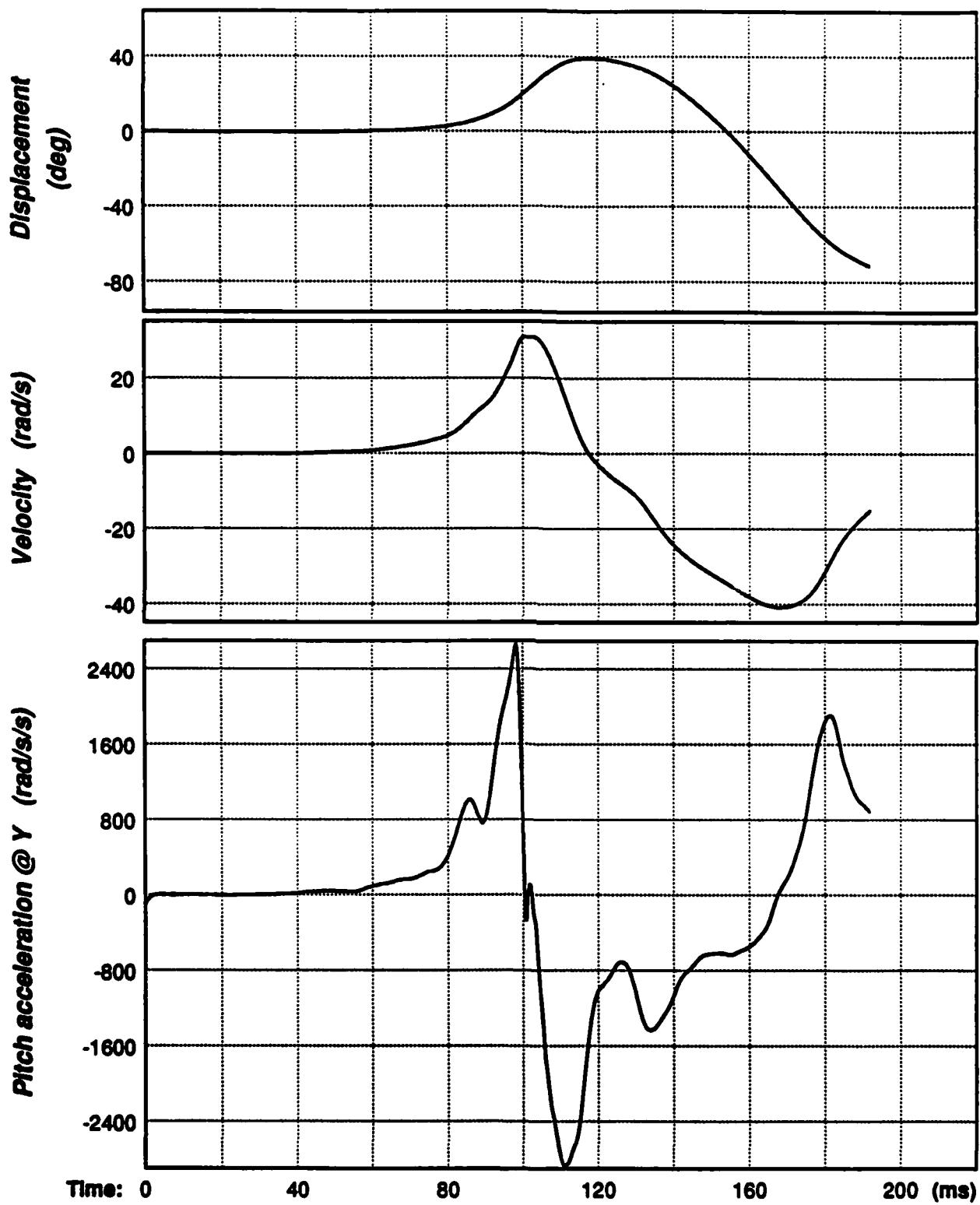


Figure A-37. Head pitch angular acceleration, velocity, and displacement signals for test LX6199.

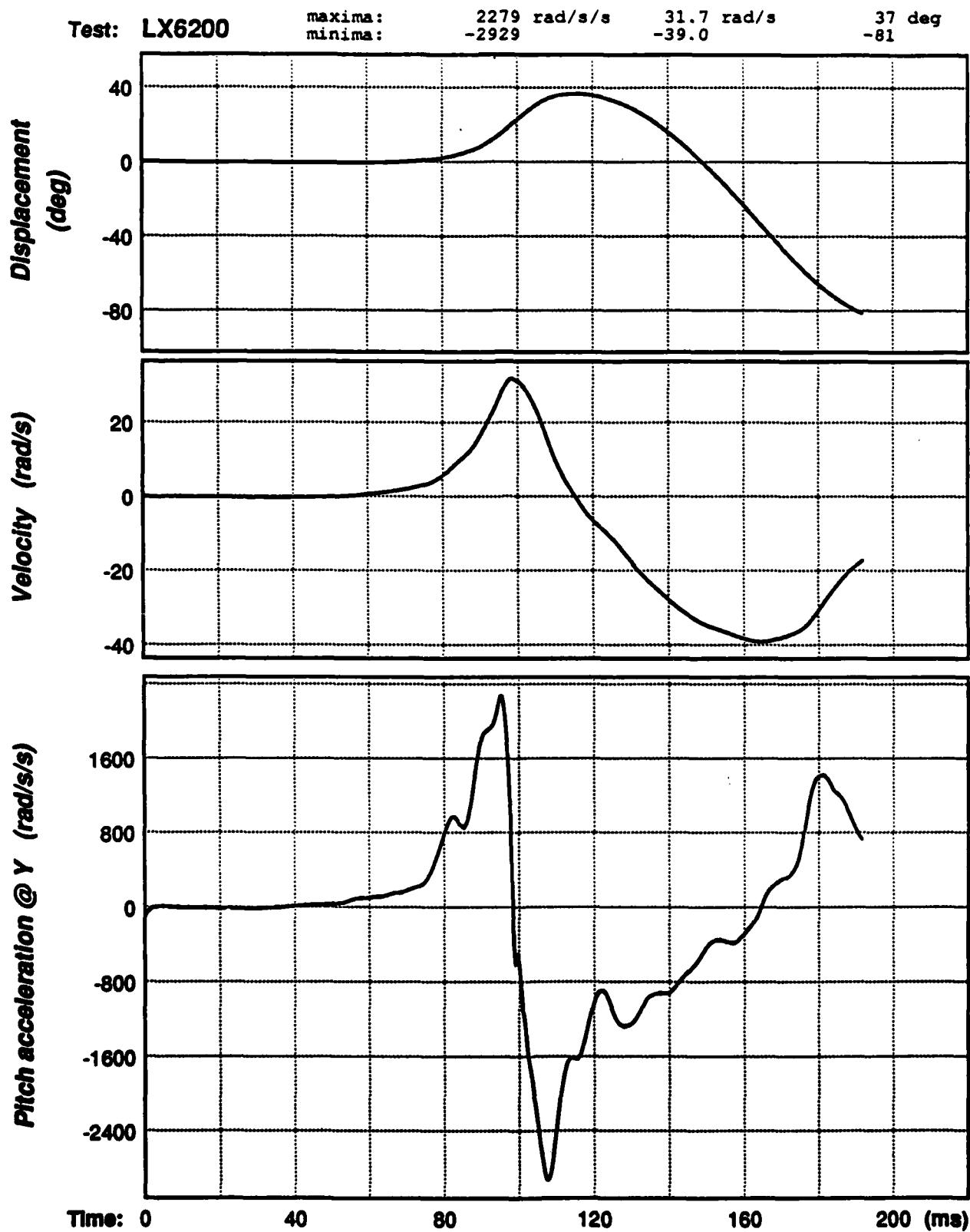


Figure A-38. Head pitch angular acceleration, velocity, and displacement signals for test LX6200.

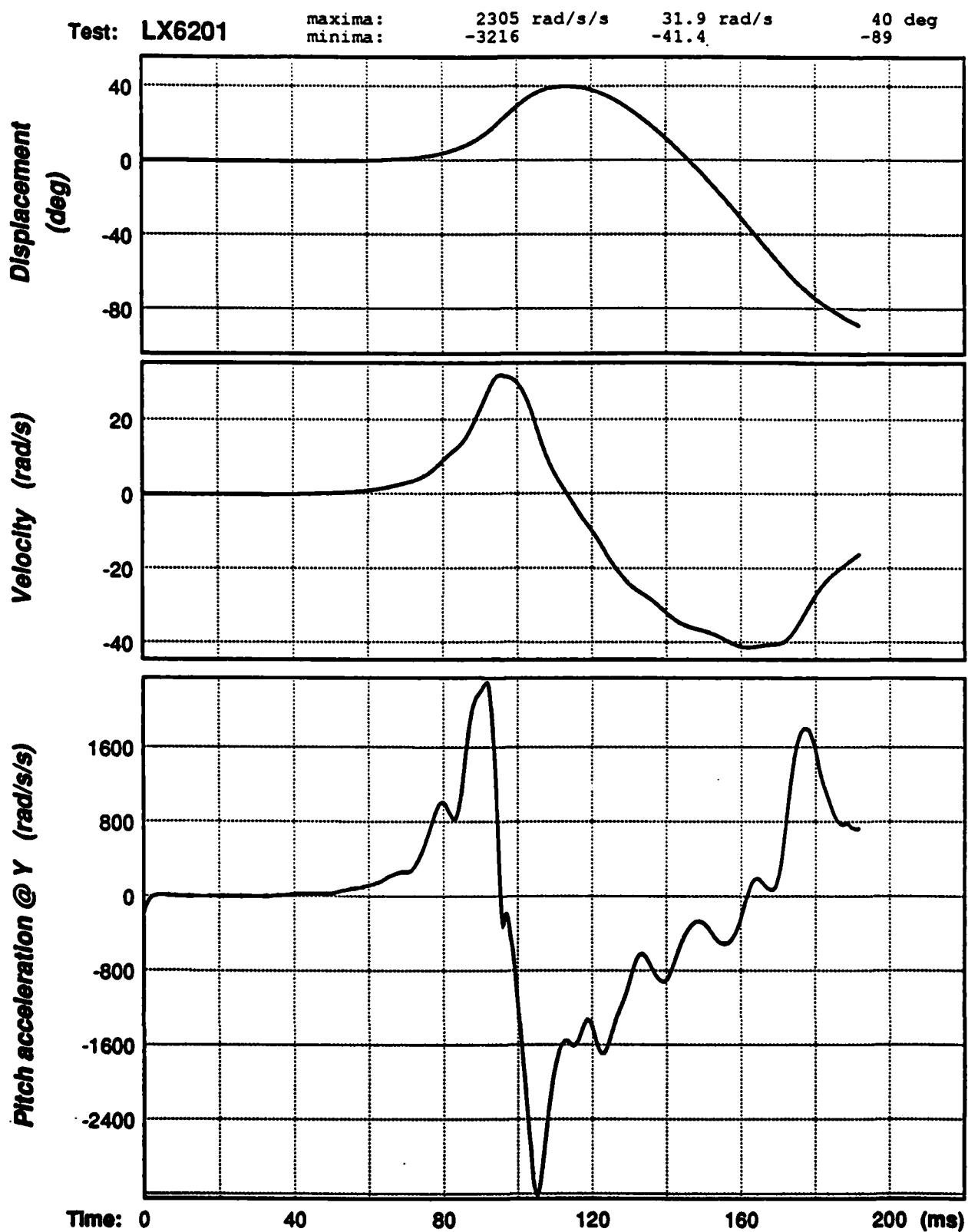


Figure A-39. Head pitch angular acceleration, velocity, and displacement signals for test LX6201.

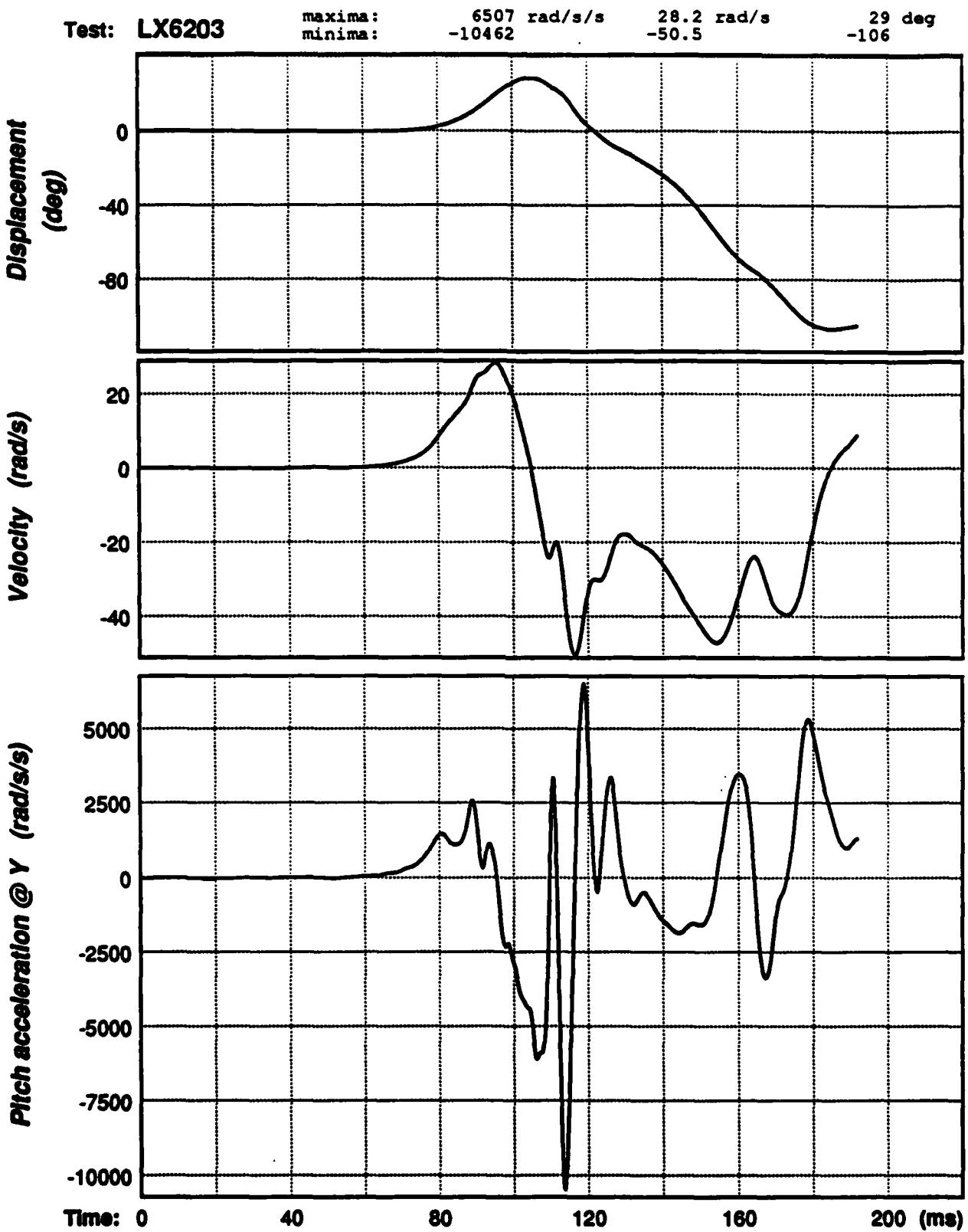


Figure A-40: Head pitch angular acceleration, velocity, and displacement signals for test LX6203.

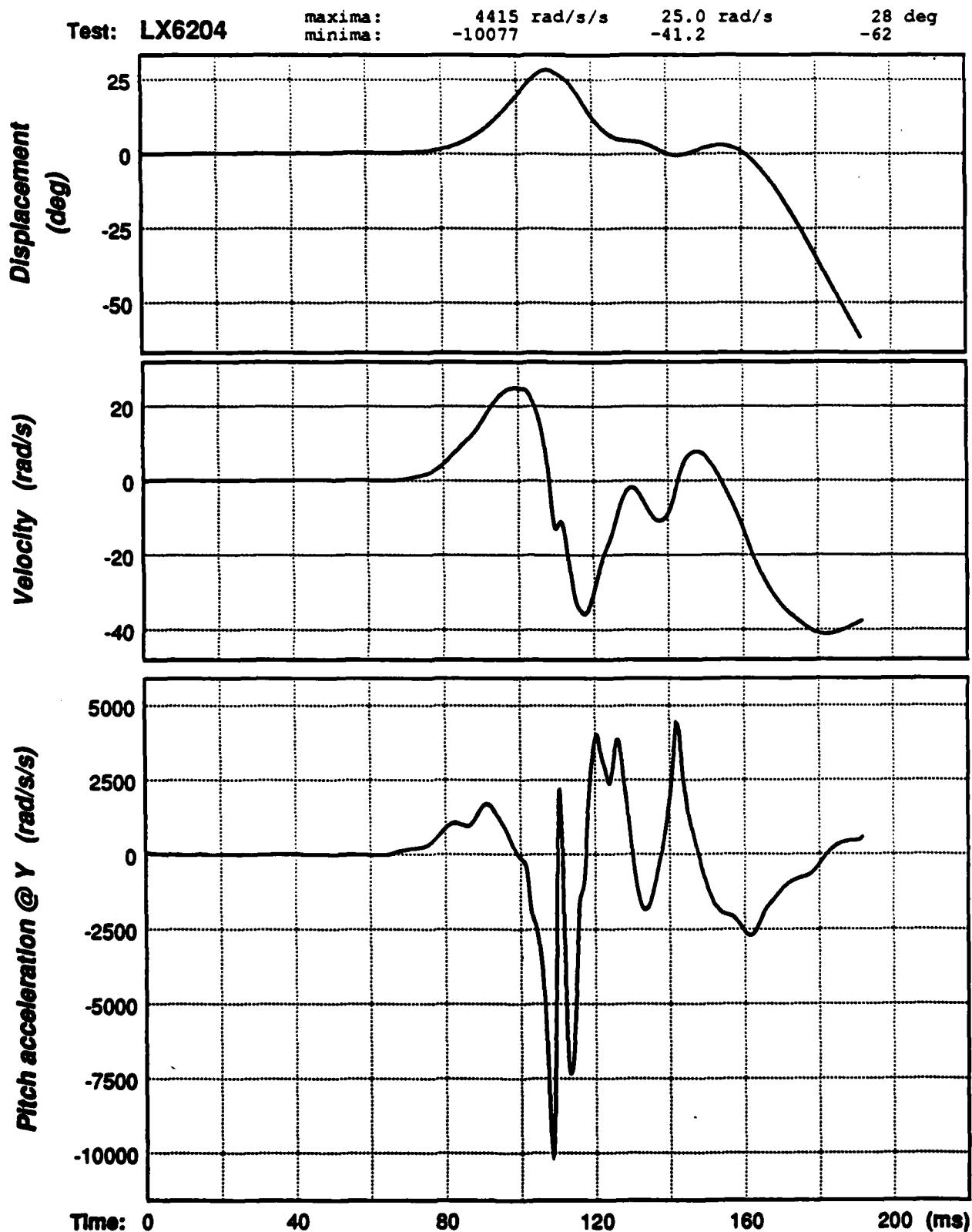


Figure A-41. Head pitch angular acceleration, velocity, and displacement signals for test LX6204.

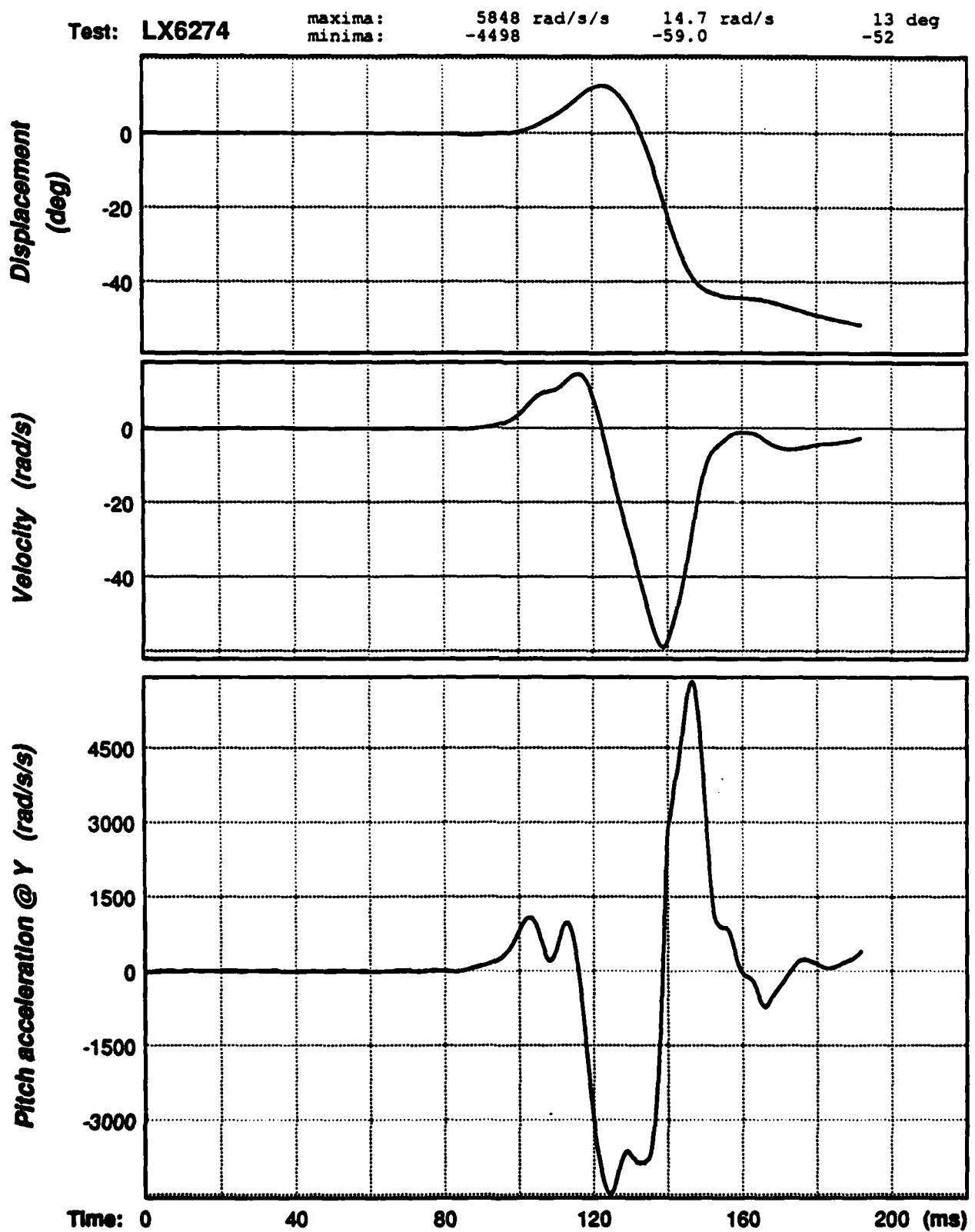


Figure A-42. Head pitch angular acceleration, velocity, and displacement signals for test LX6274.

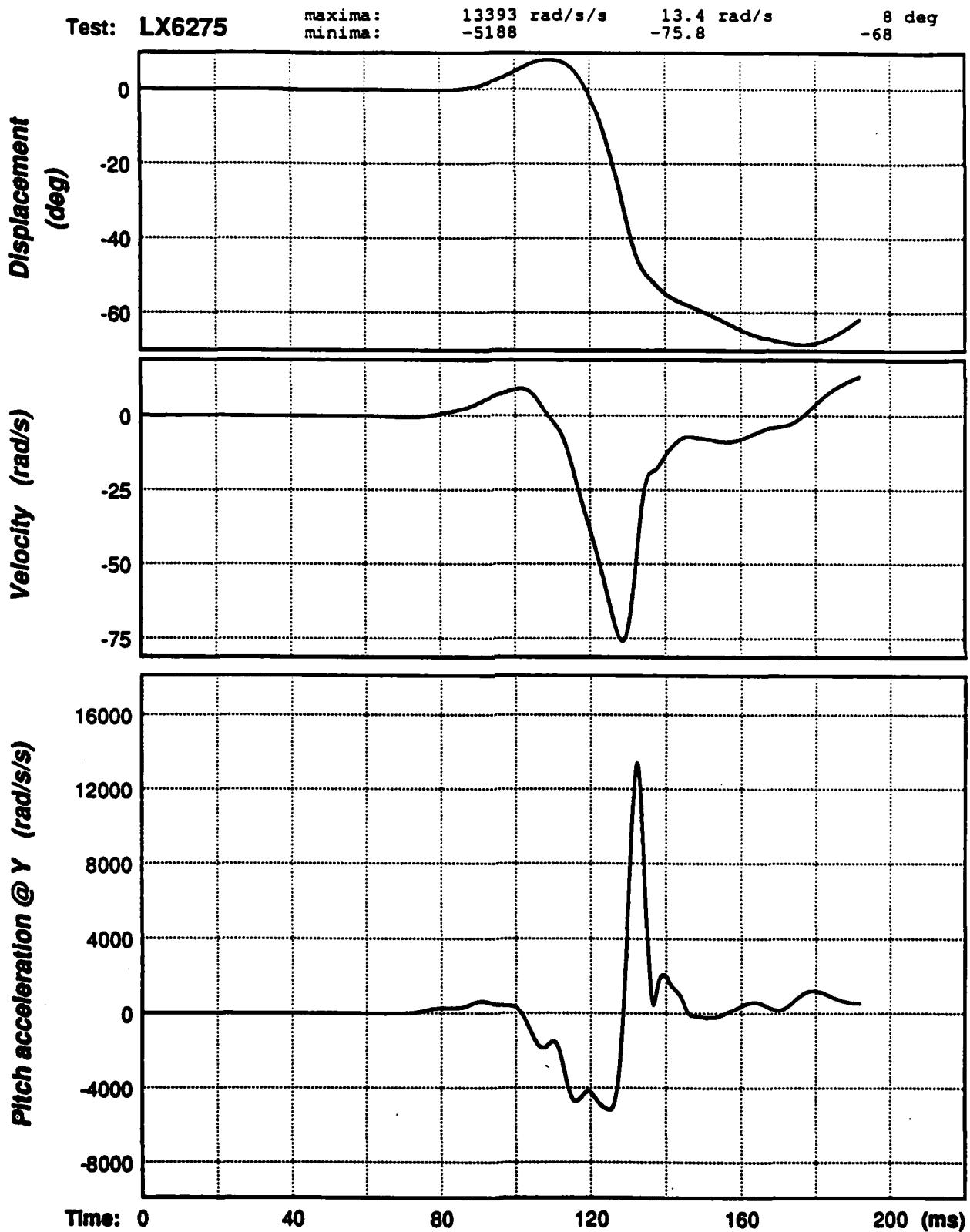


Figure A-43. Head pitch angular acceleration, velocity, and displacement signals for test LX6275.

Test: LX6276 maxima: 3509 rad/s/s
minima: -5044 -40.0 13.4 rad/s 13 deg
-50

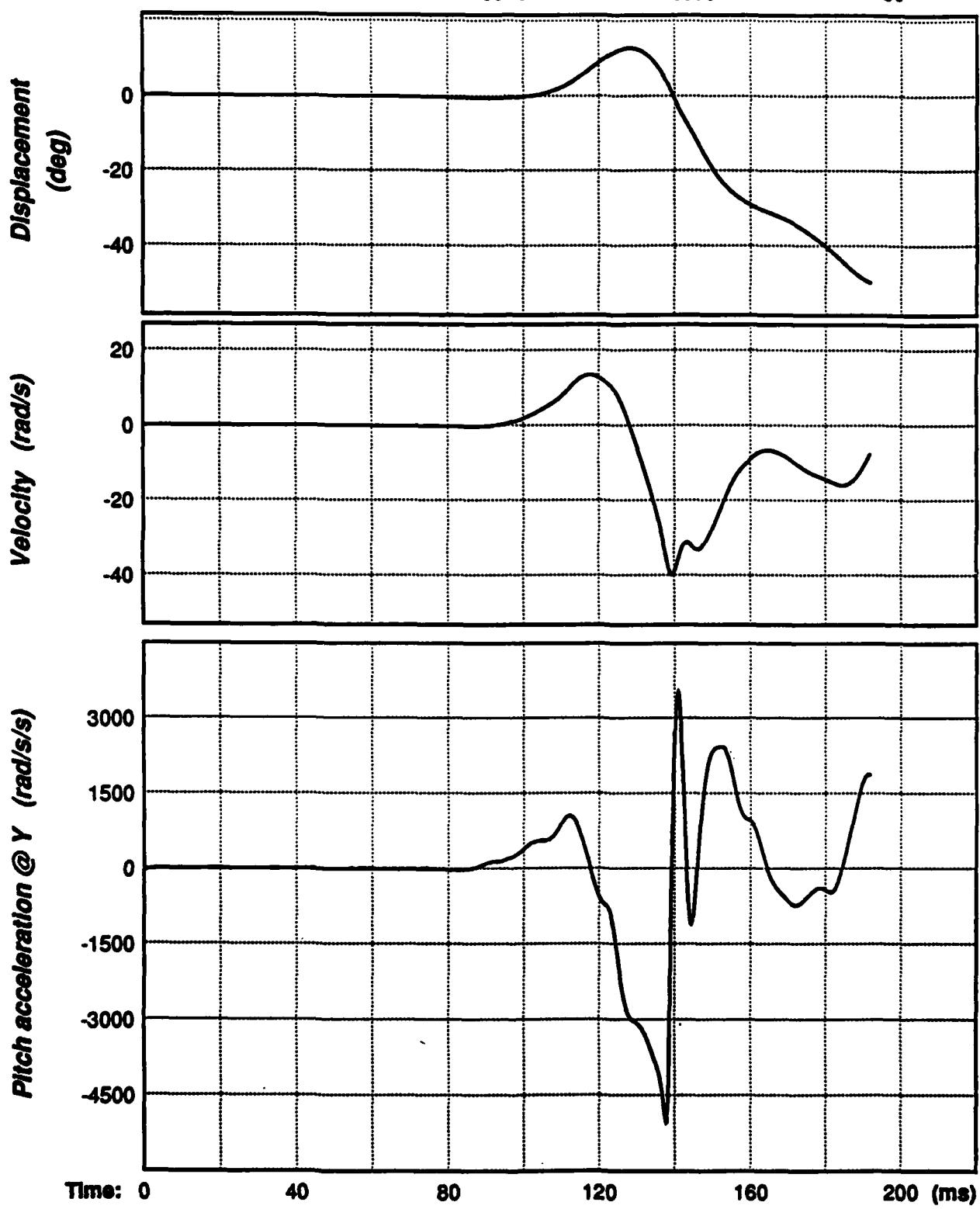


Figure A-44. Head pitch angular acceleration, velocity, and displacement signals for test LX6276.

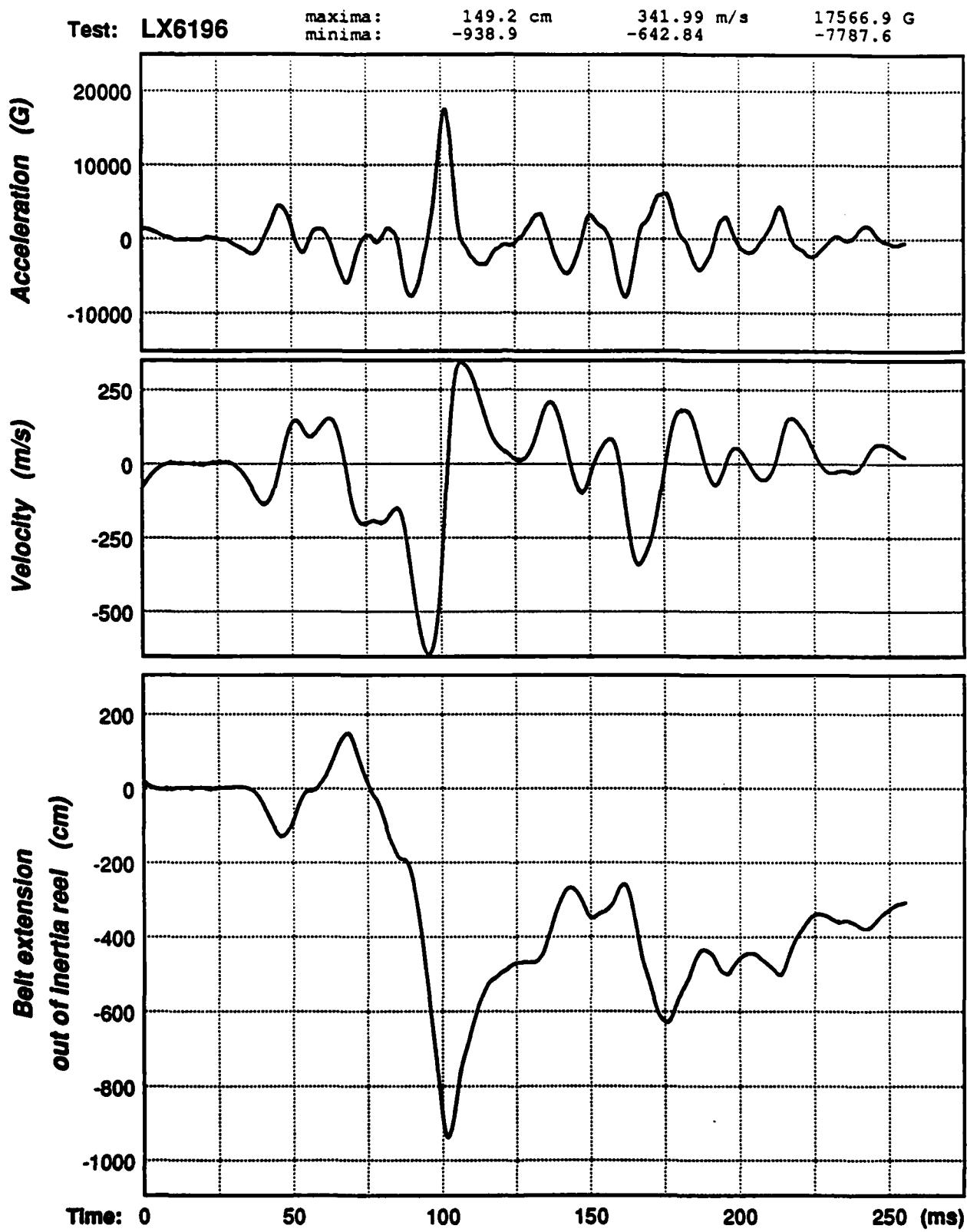


Figure A-45. Amount of belt extension and the velocity and acceleration of extension for test LX6196.

Test: LX6197

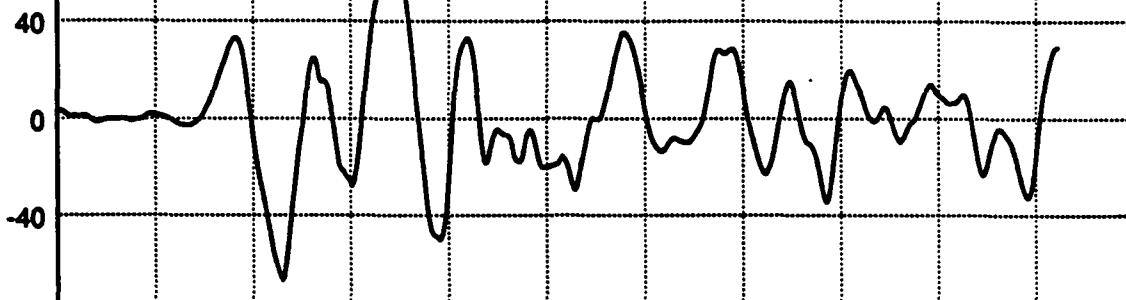
maxima:
minima:

3.0 cm
-3.5

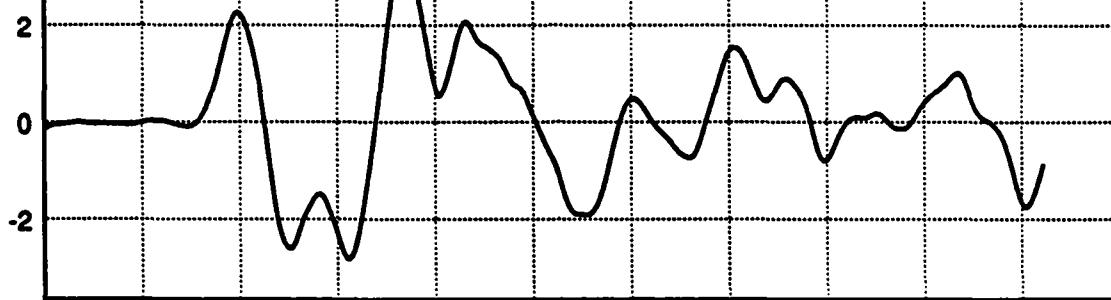
3.48 m/s
-2.83

69.1 G
-66.3

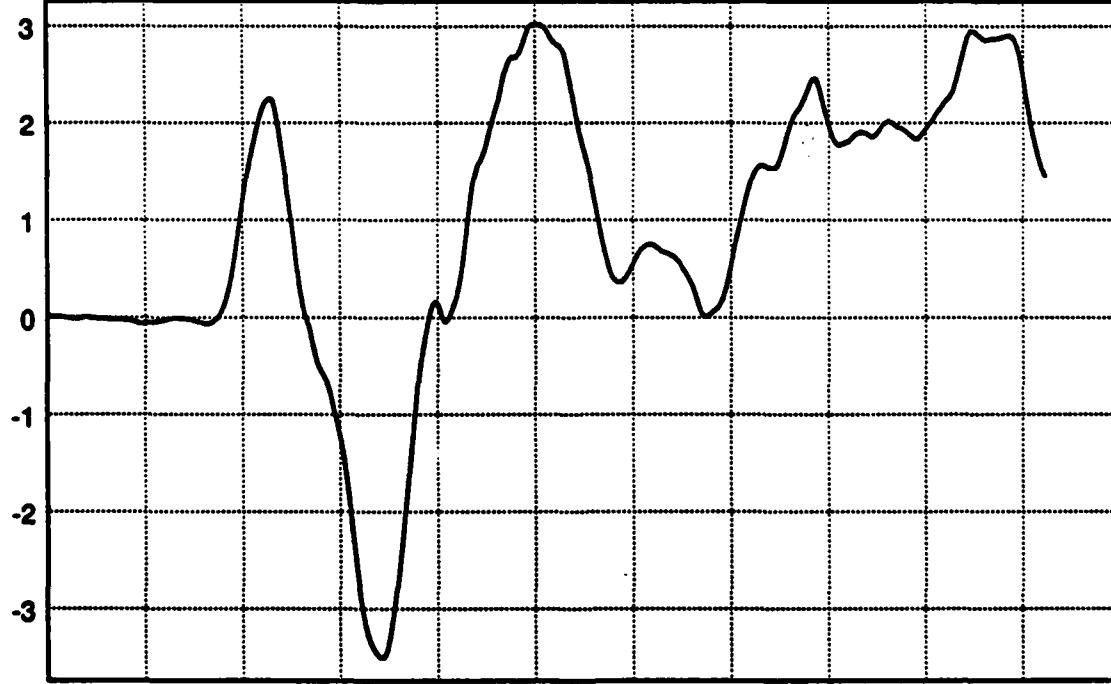
Acceleration (G)



Velocity (m/s)



Belt extension
out of inertia reel (cm)



Time: 0 50 100 150 200 250 (ms)

Figure A-46. Amount of belt extension and the velocity and acceleration of extension for test LX6197.

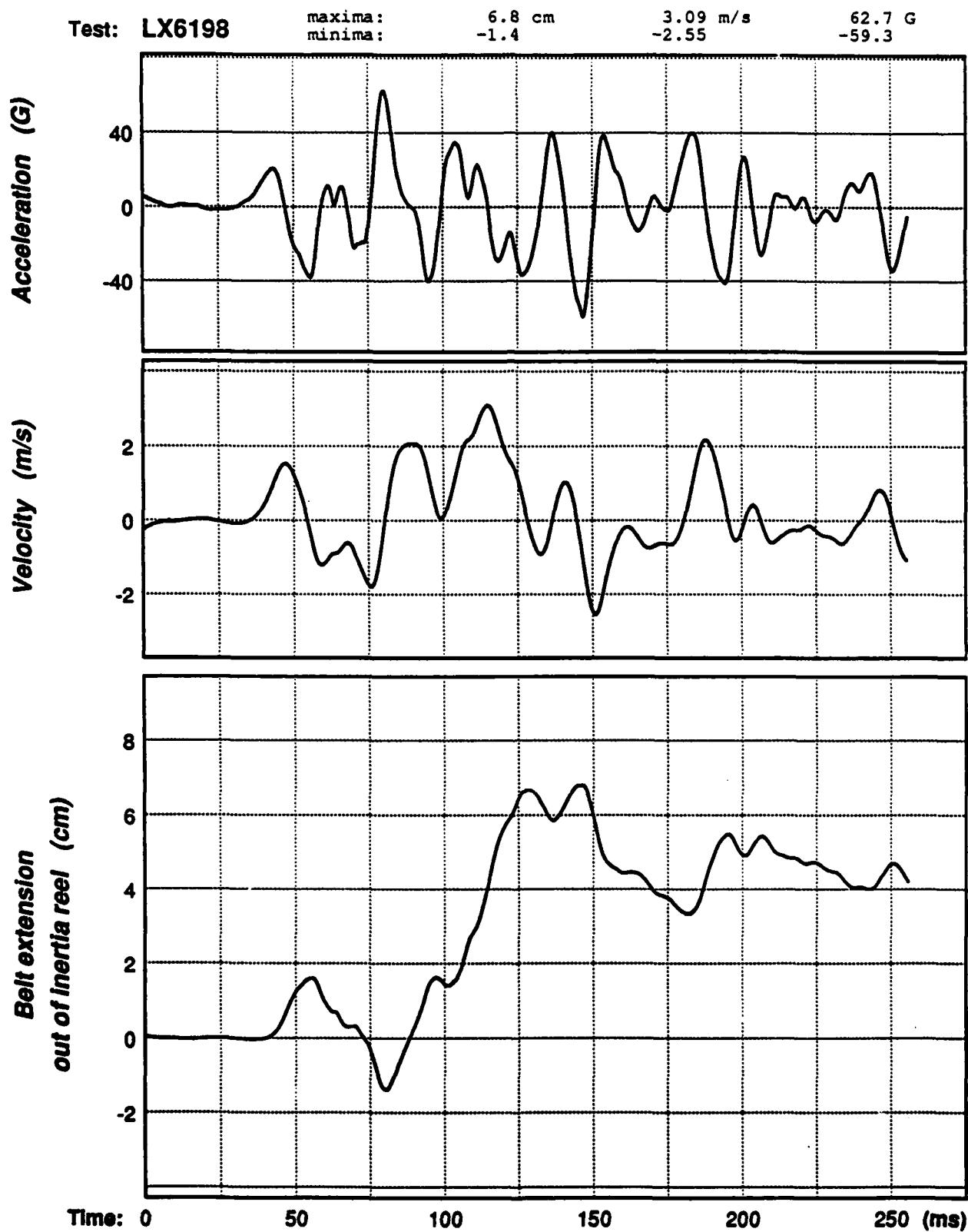


Figure A-47. Amount of belt extension and the velocity and acceleration of extension for test LX6198.

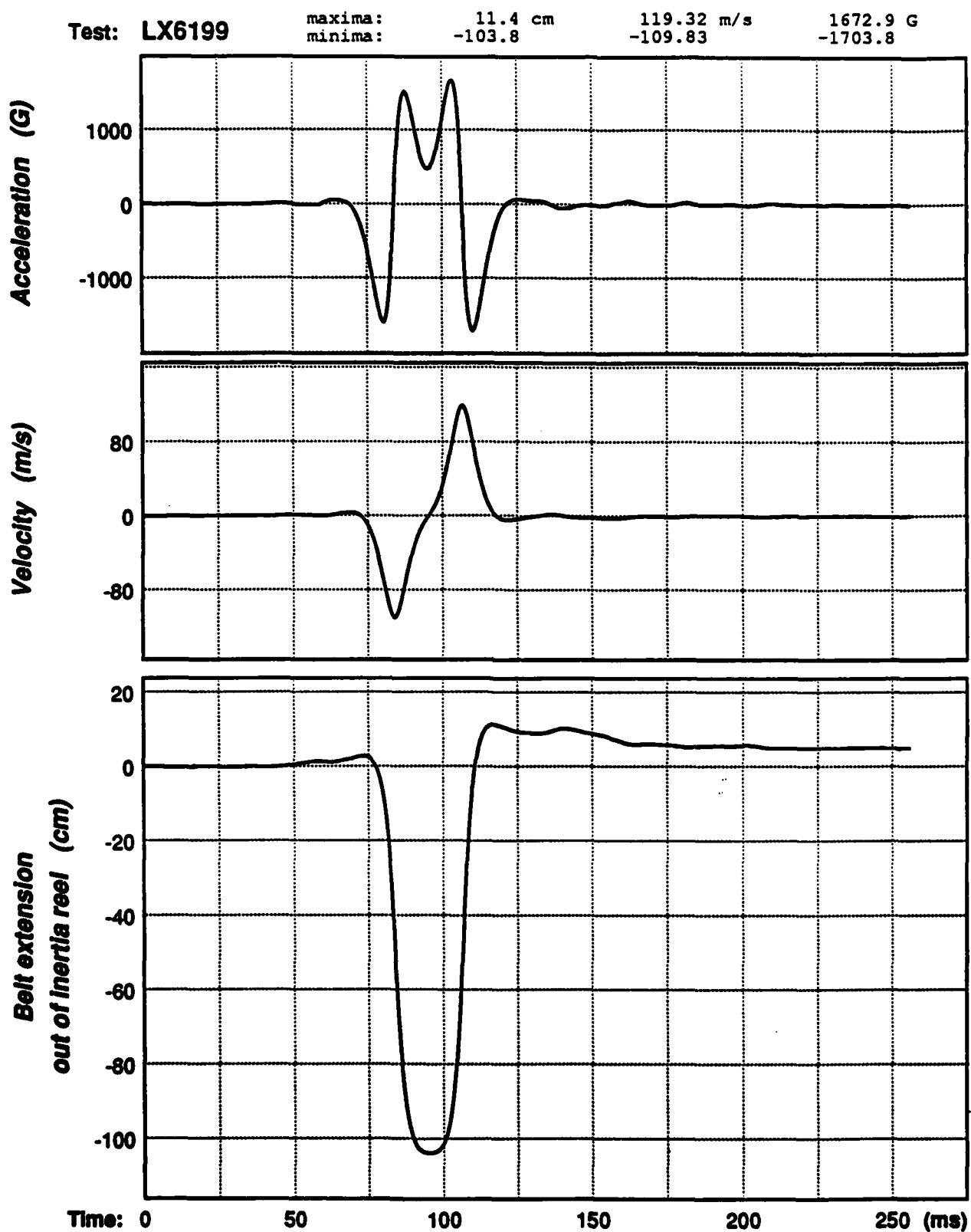


Figure A-48. Amount of belt extension and the velocity and acceleration of extension for test LX6199.

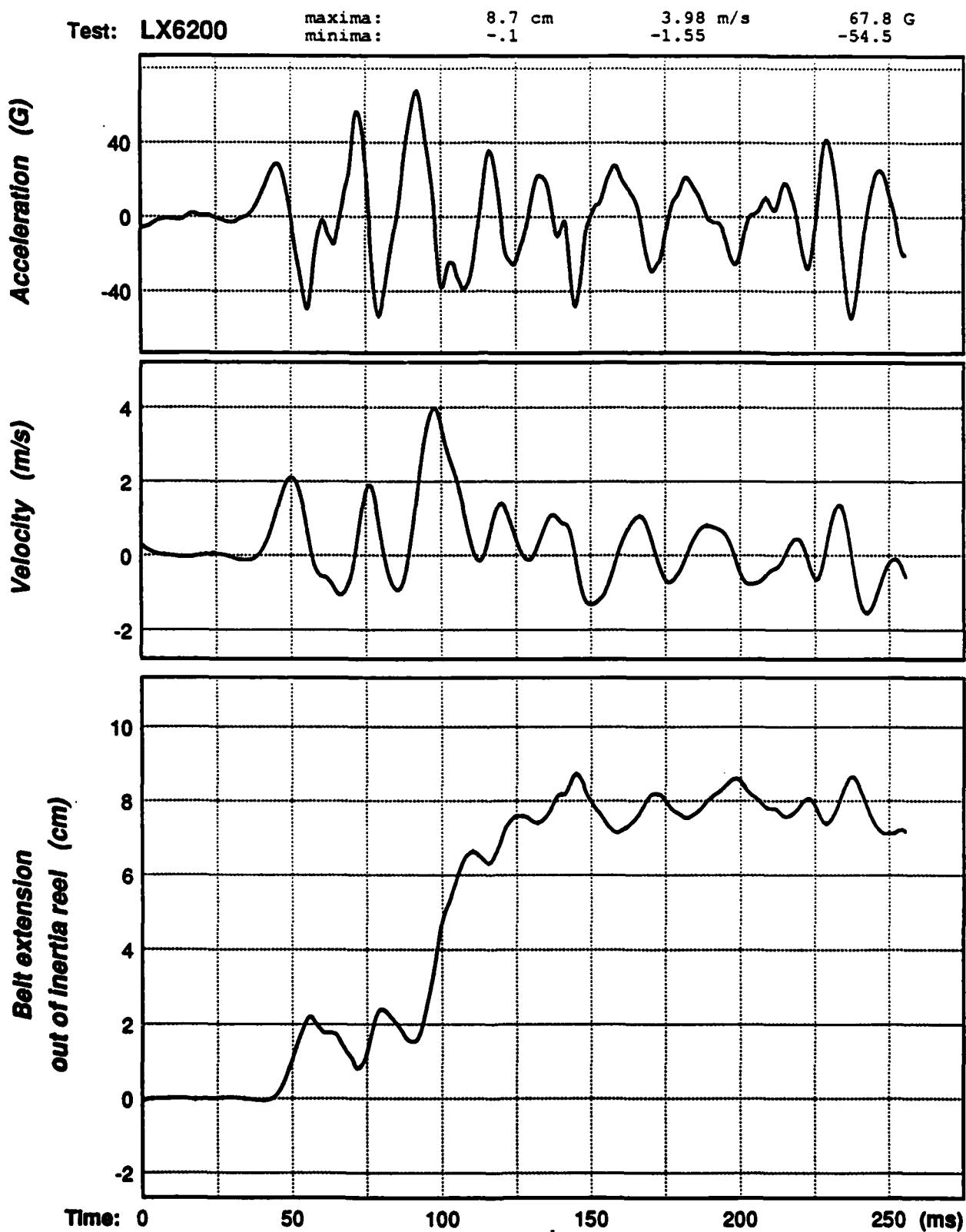


Figure A-49. Amount of belt extension and the velocity and acceleration of extension for test LX6200.

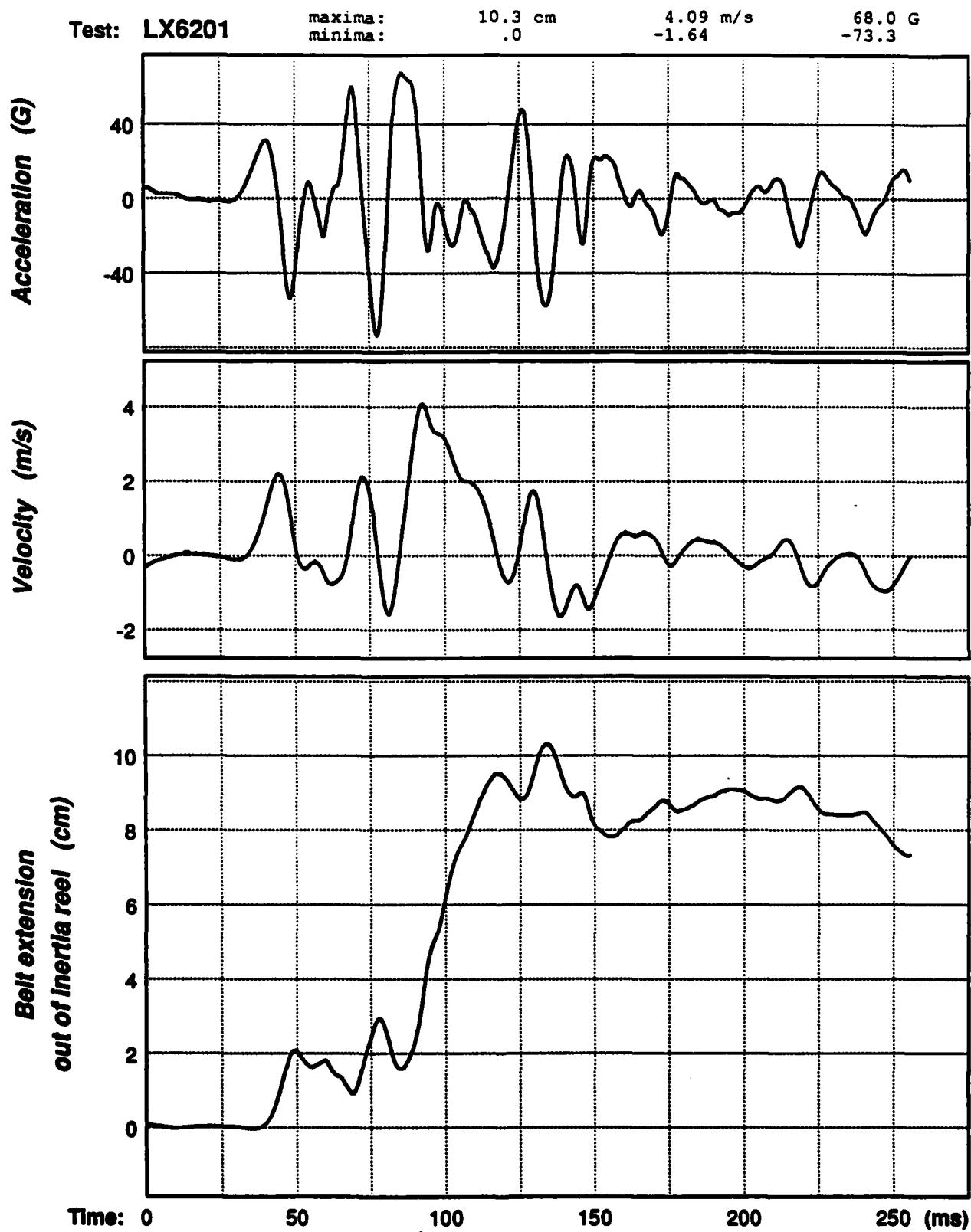


Figure A-50. Amount of belt extension and the velocity and acceleration of extension for test LX6201.

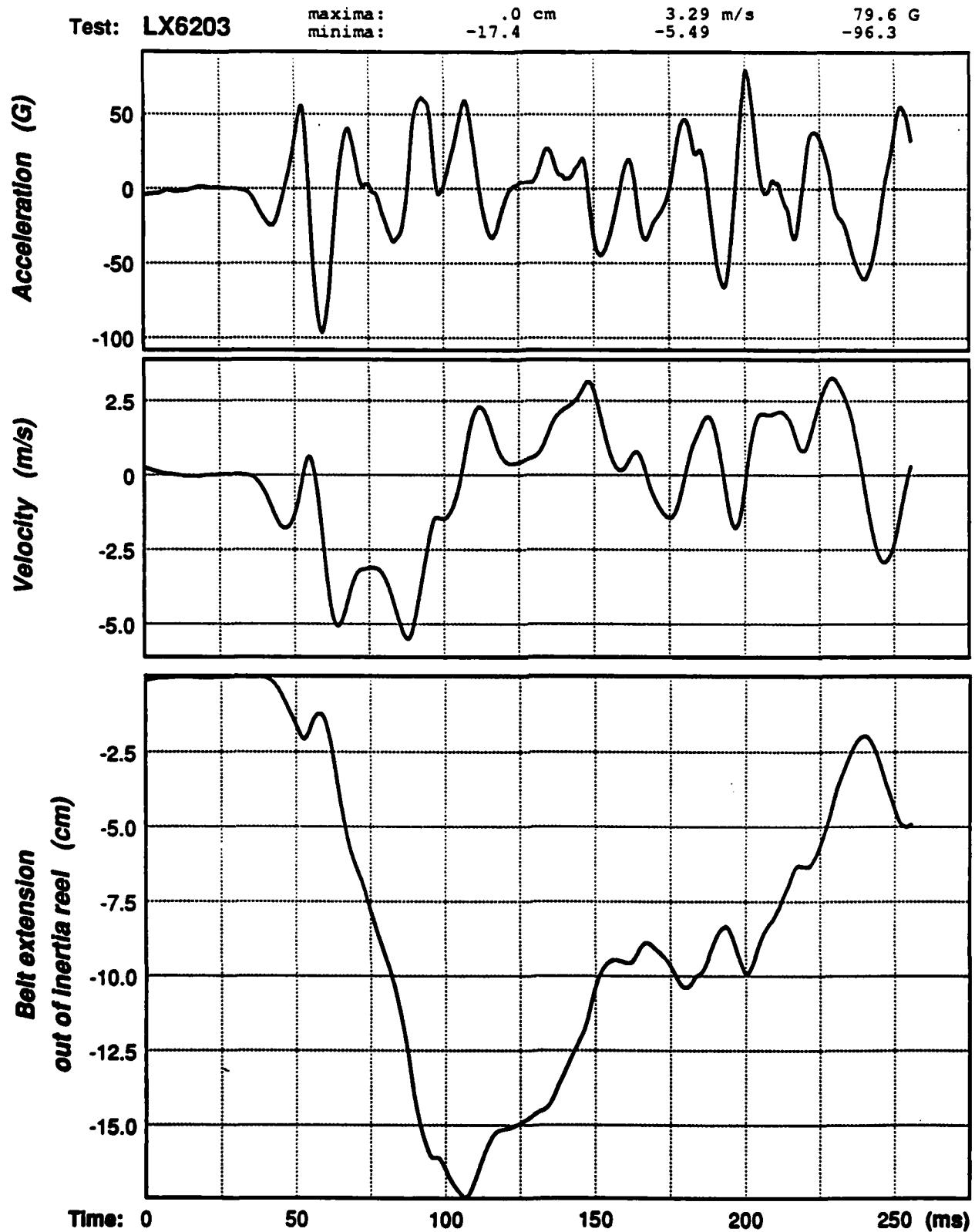


Figure A-51. Amount of belt extension and the velocity and acceleration of extension for test LX6203.

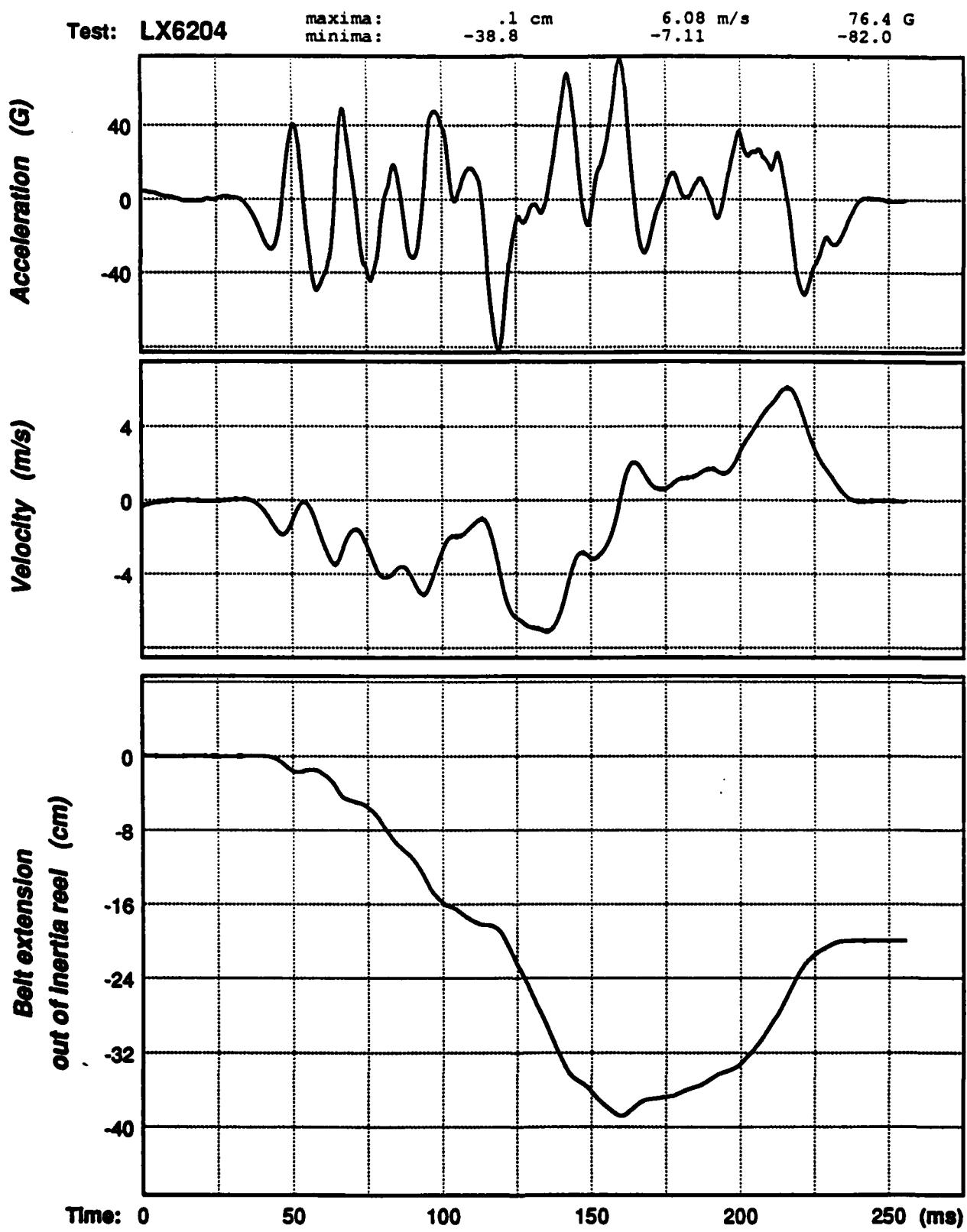


Figure A-52. Amount of belt extension and the velocity and acceleration of extension for test LX6204.

Test: LX6274

maxima:
minima:

3.6 cm
-.3

1.02 m/s
-.32

11.7 G
-9.7

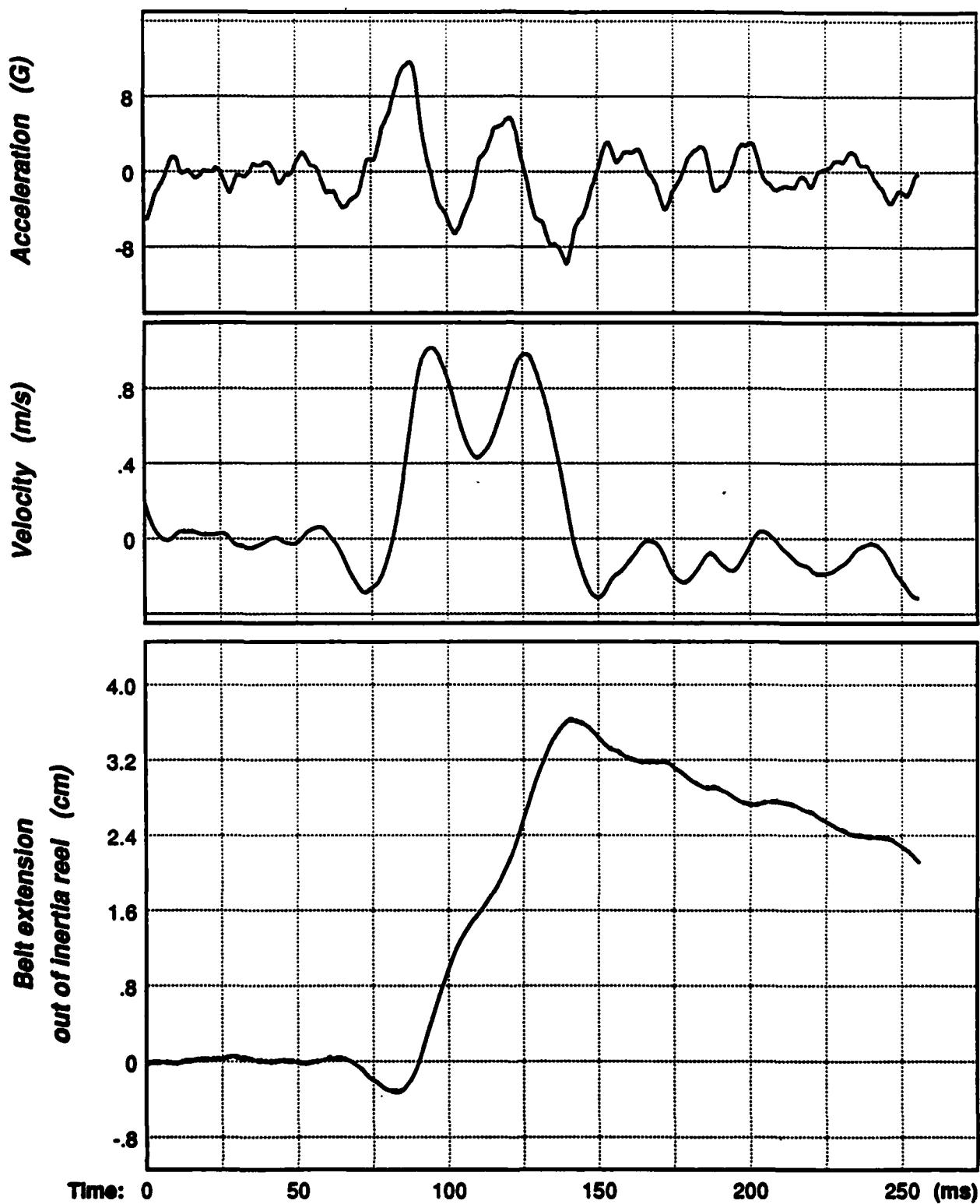


Figure A-53. Amount of belt extension and the velocity and acceleration of extension for test LX6274.

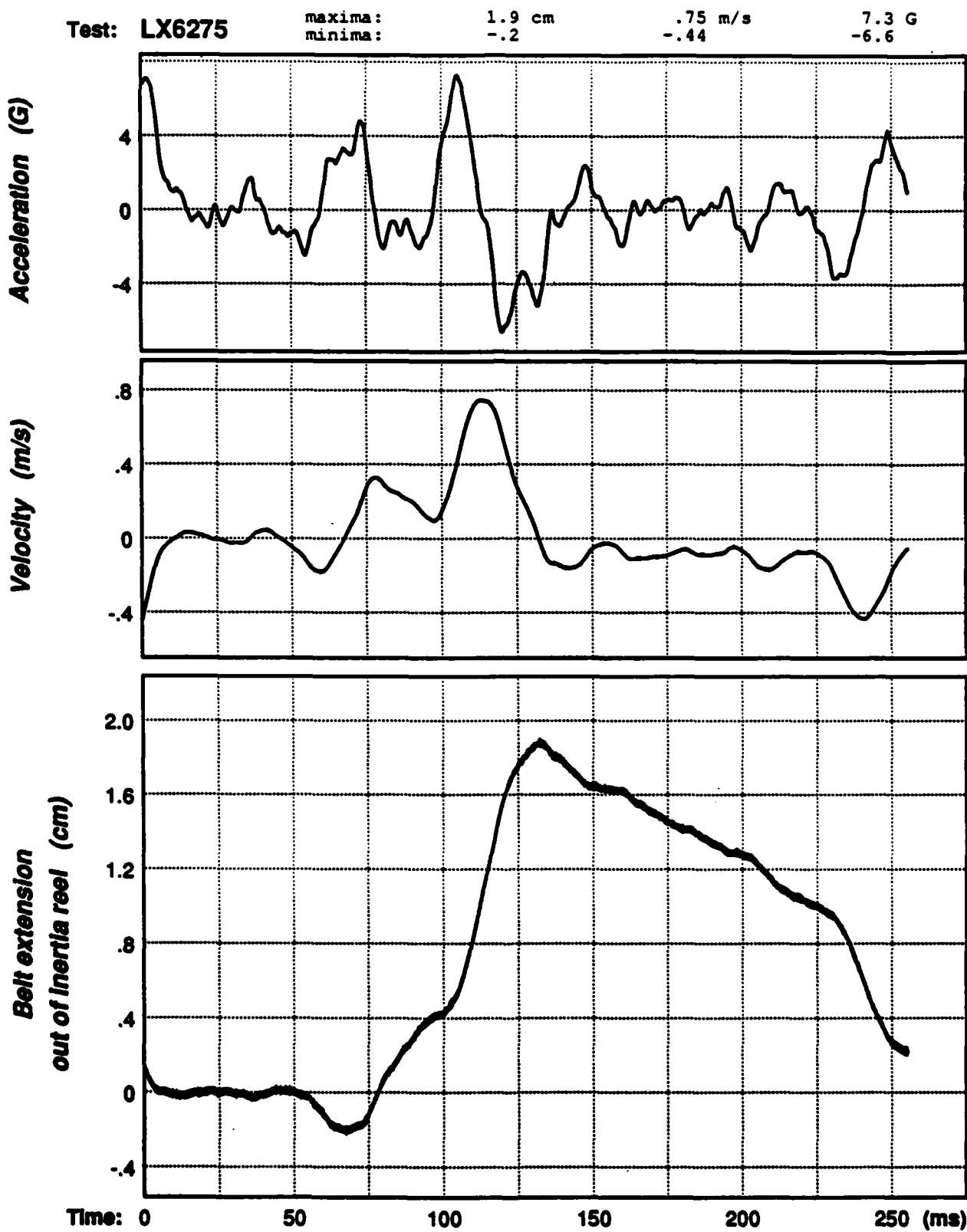


Figure A-54. Amount of belt extension and the velocity and acceleration of extension for test LX6275.

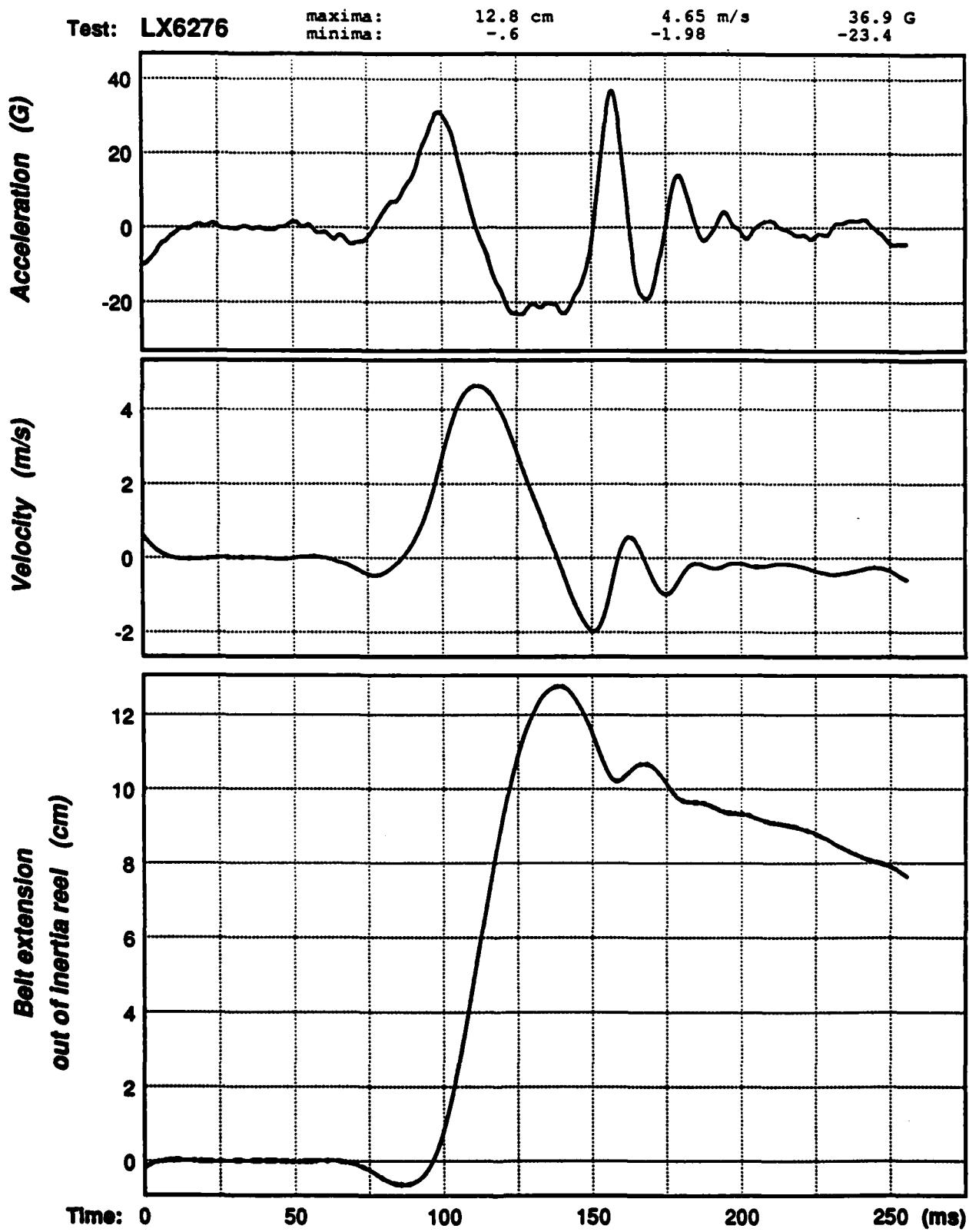


Figure A-55. Amount of belt extension and the velocity and acceleration of extension for test LX6276.

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Appendix B

This appendix contains the processed transducer signals from the 11 AH-64 (Apache) optical relay tube (ORT) tests with inertia reels and without airbags.

These include 10 tests (LX6208 - LX6217) conducted during the first phase of testing and one test (LX6277) which were run in the second phase.

Figures B-1 thru B-11 show the sled acceleration pulses and computed velocity and jerk signals for the 11 tests.

Figures B-12 thru B-22 display components and resultants head linear accelerations.

Figures B-23 thru B-33 display the head roll acceleration signals and computed angular velocities and displacements.

Figures B-34 thru B-44 show the head pitch acceleration signals and computed angular velocities and displacements.

No belt extension signals were available for these tests.

Appendix B

- 1. LX6208**
- 2. LX6209**
- 3. LX6210**
- 4. LX6211**
- 5. LX6212**
- 6. LX6213**
- 7. LX6214**
- 8. LX6215**
- 9. LX6216**
- 10. LX6217**
- 11. LX6277**

Test: LX6208 maxima: 6.68 G
 minima: -.51

10.71 m/s
:00

674 G/s
-150

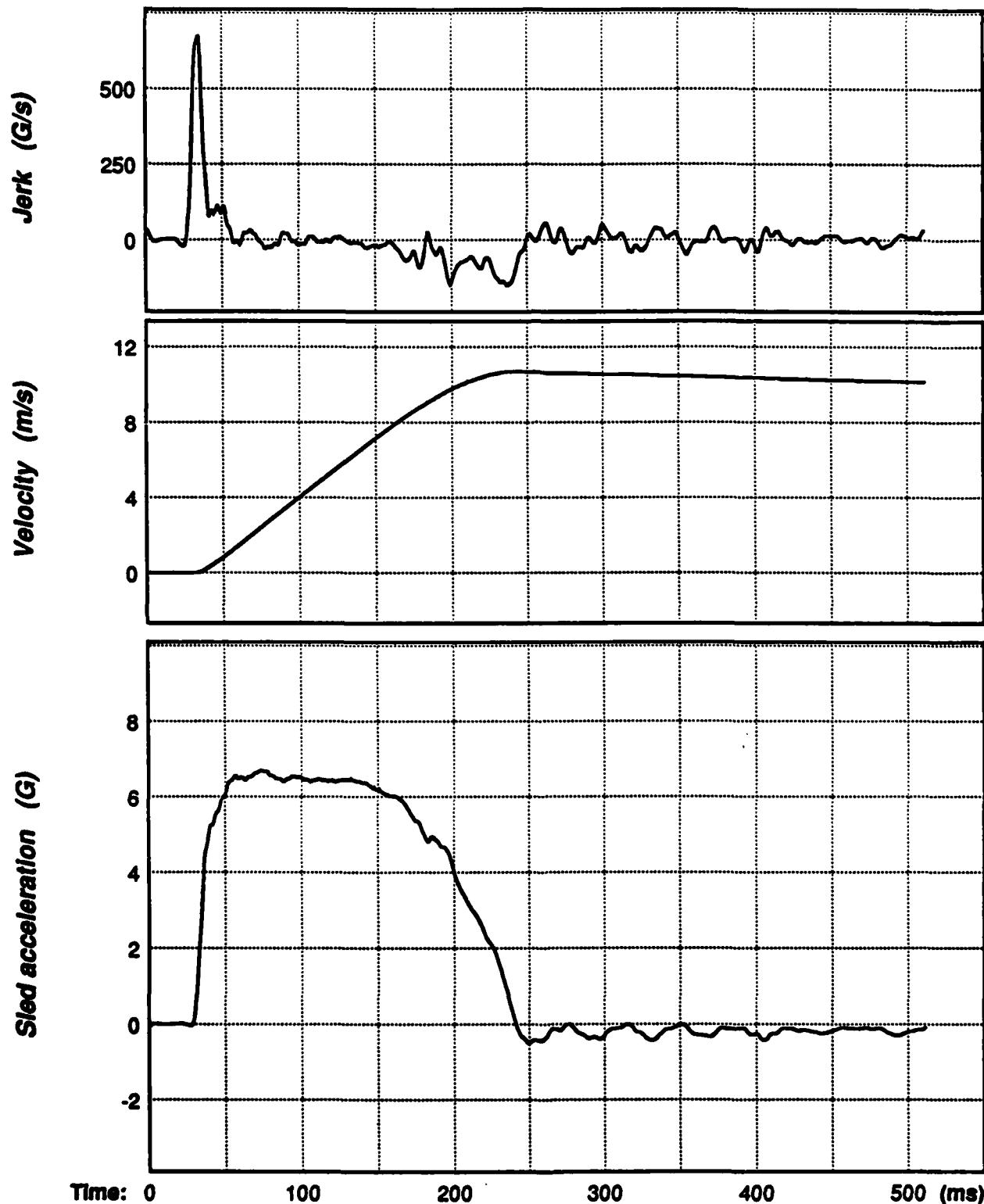


Figure B-1. Sled acceleration signal and its computed velocity and jerk for test LX6208.

Test: LX6209 maxima: 6.72 G 10.69 m/s 701 G/s
minima: -.62 .00 -257

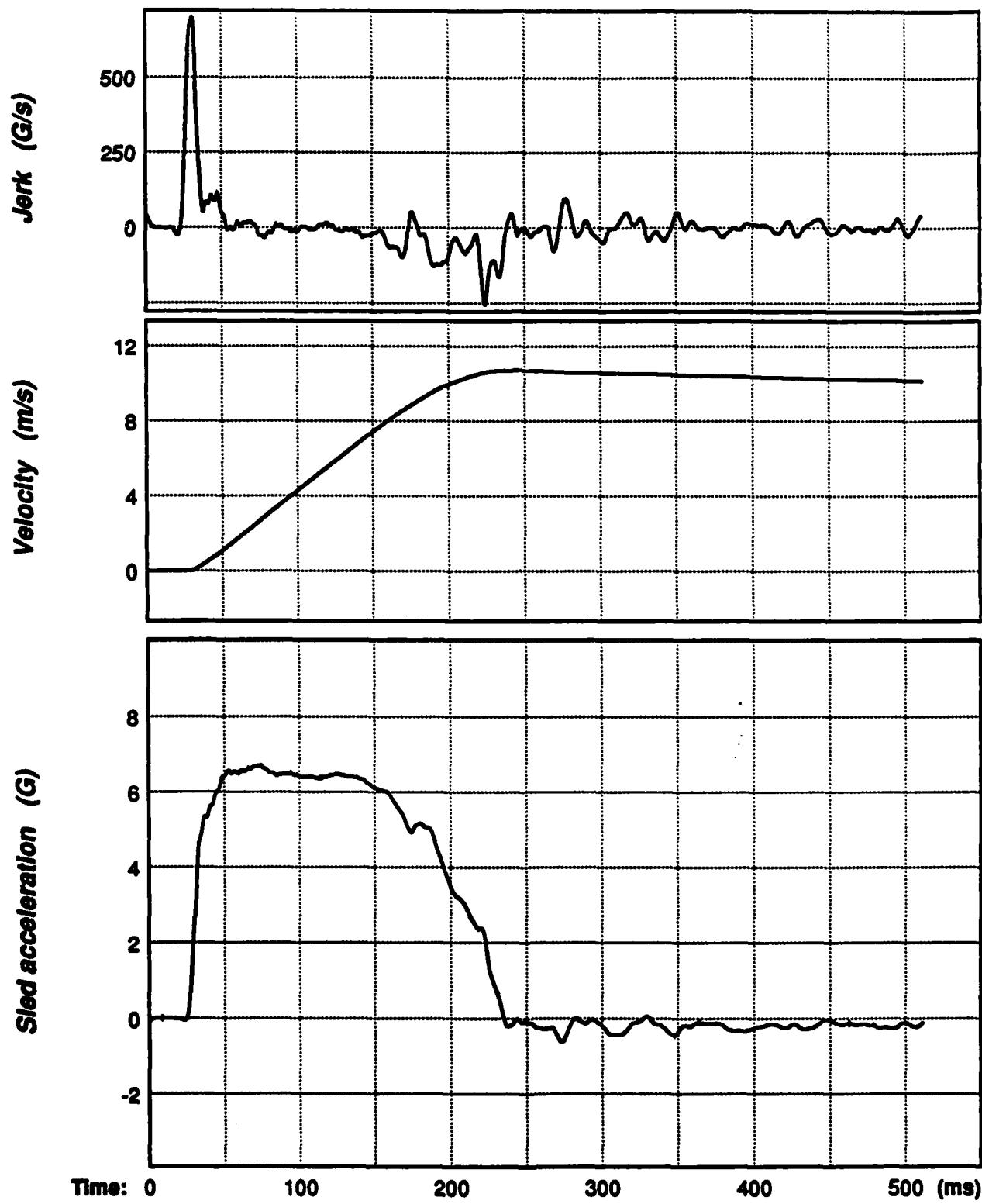


Figure B-2. Sled acceleration signal and its computed velocity and jerk for test LX6209.

Test: LX6210 maxima: 6.71 G
 minima: -.64

10.69 m/s
.00

710 G/s
-272

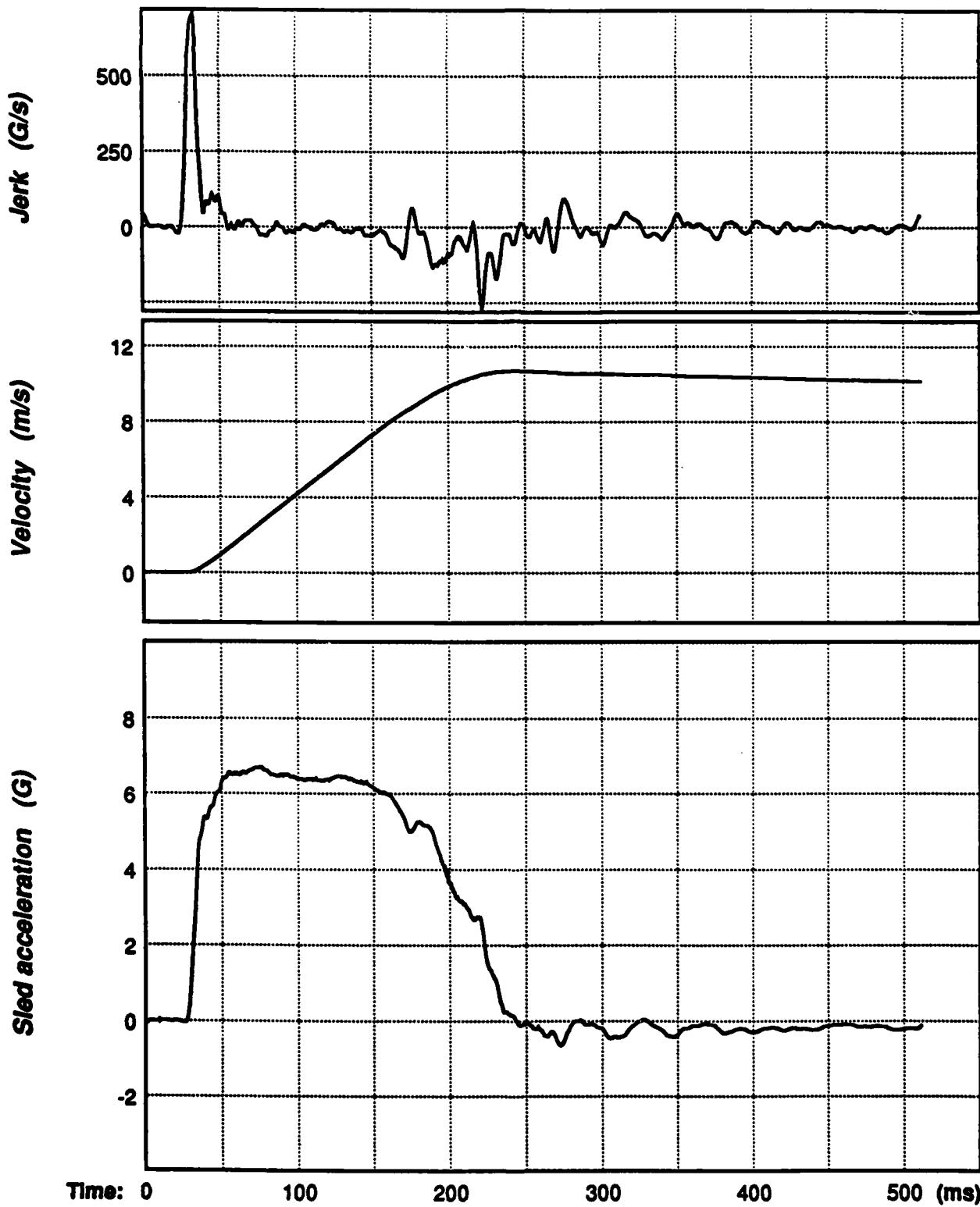


Figure B-3. Sled acceleration signal and its computed velocity and jerk for test LX6210.

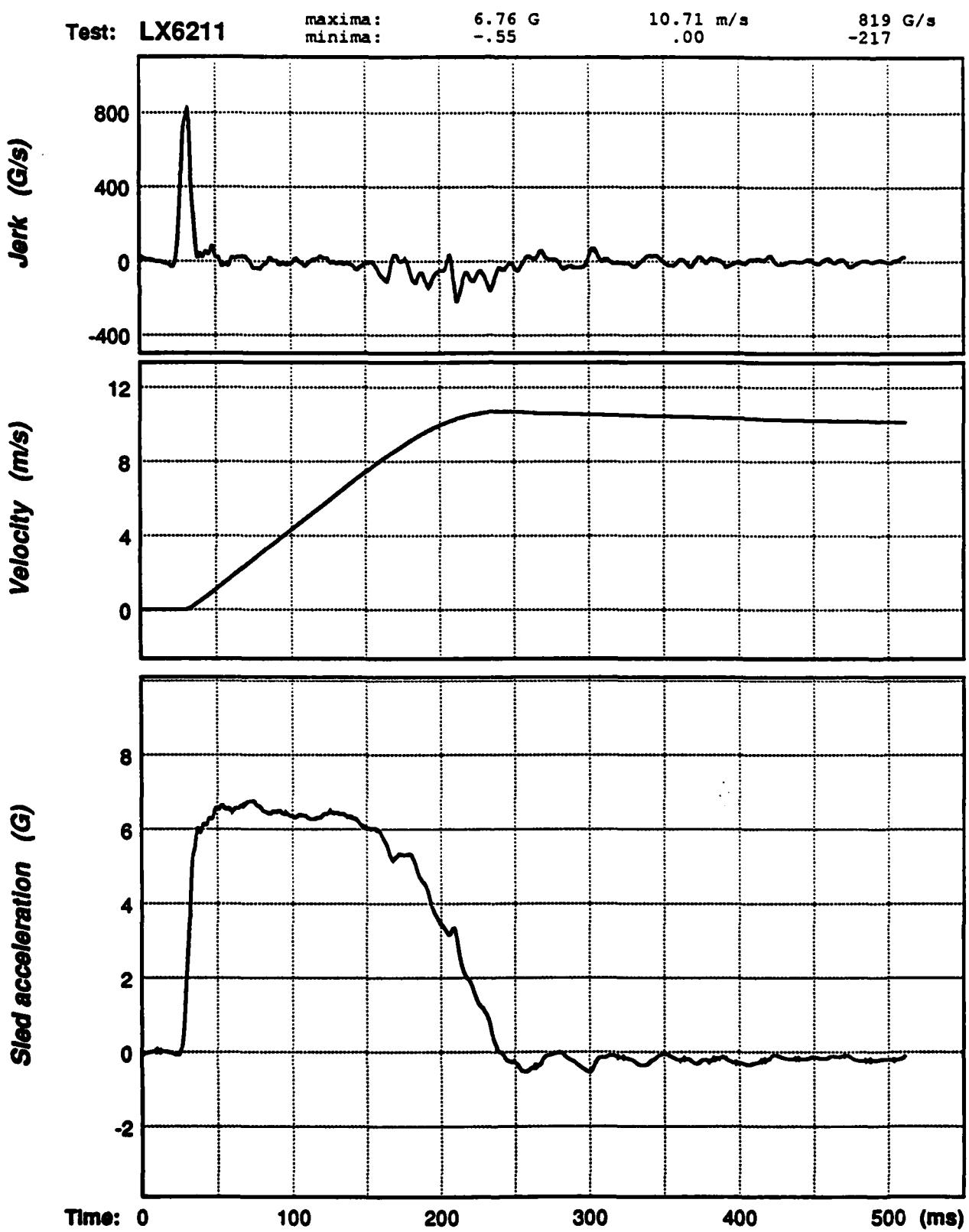


Figure B-4. Sled acceleration signal and its computed velocity and jerk for test LX6211.

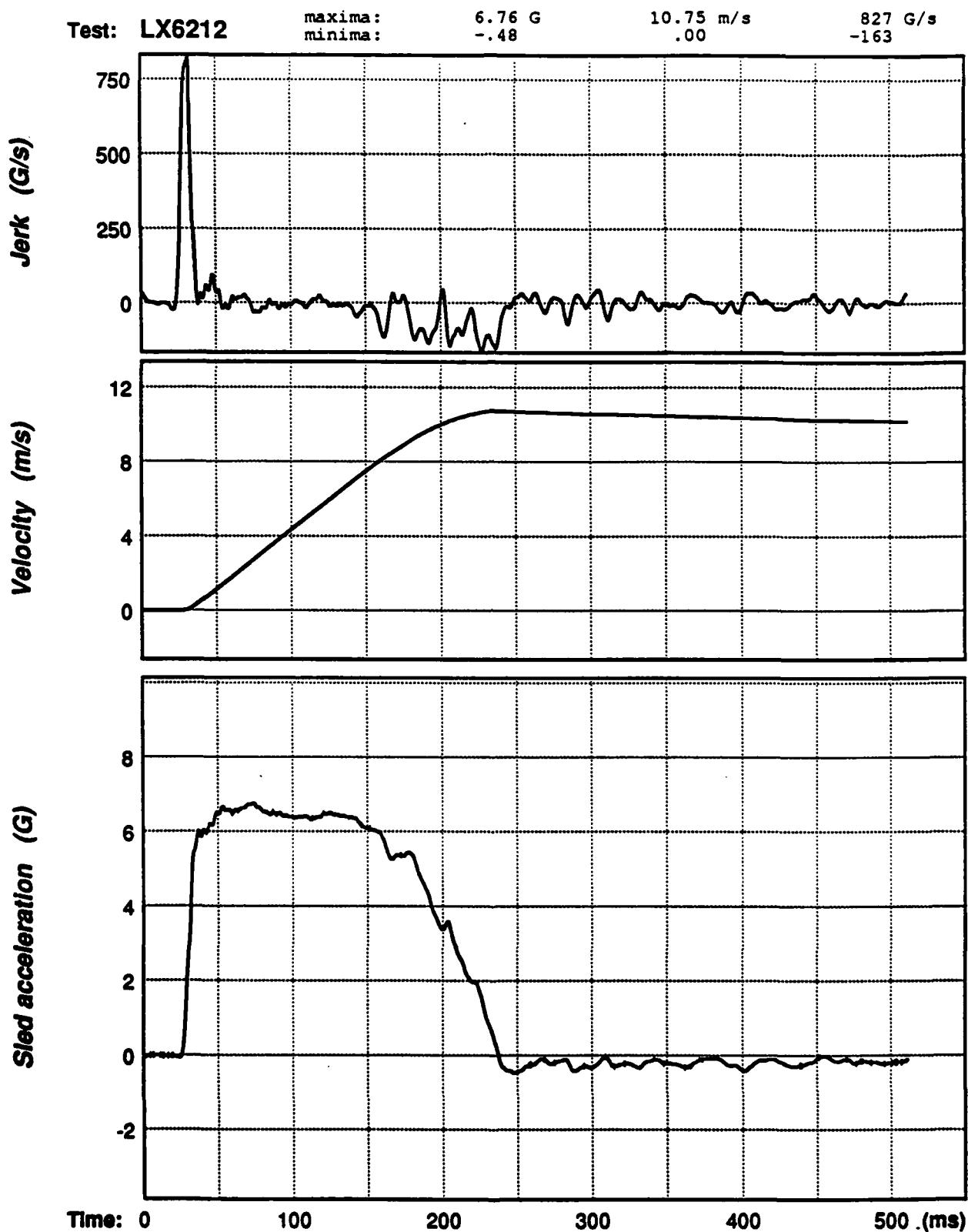


Figure B-5. Sled acceleration signal and its computed velocity and jerk for test LX6212.

Test: LX6213 maxima: 6.77 G 10.73 m/s 837 G/s
 minima: -.56 .00 -258

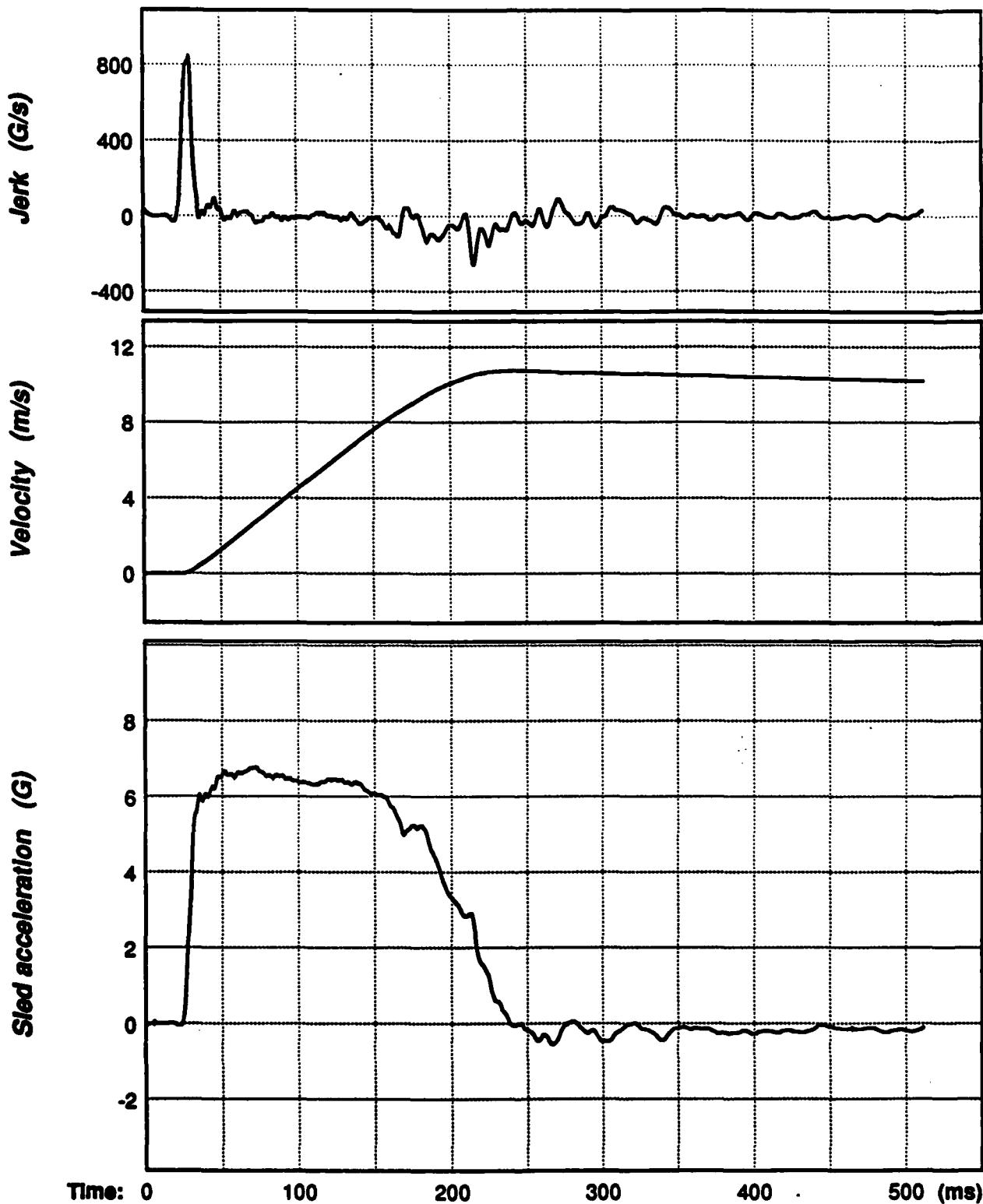


Figure B-6. Sled acceleration signal and its computed velocity and jerk for test LX6213.

Test: LX6214 maxima: 6.76 G 10.75 m/s 712 G/s
minima: -.37 .00 -137

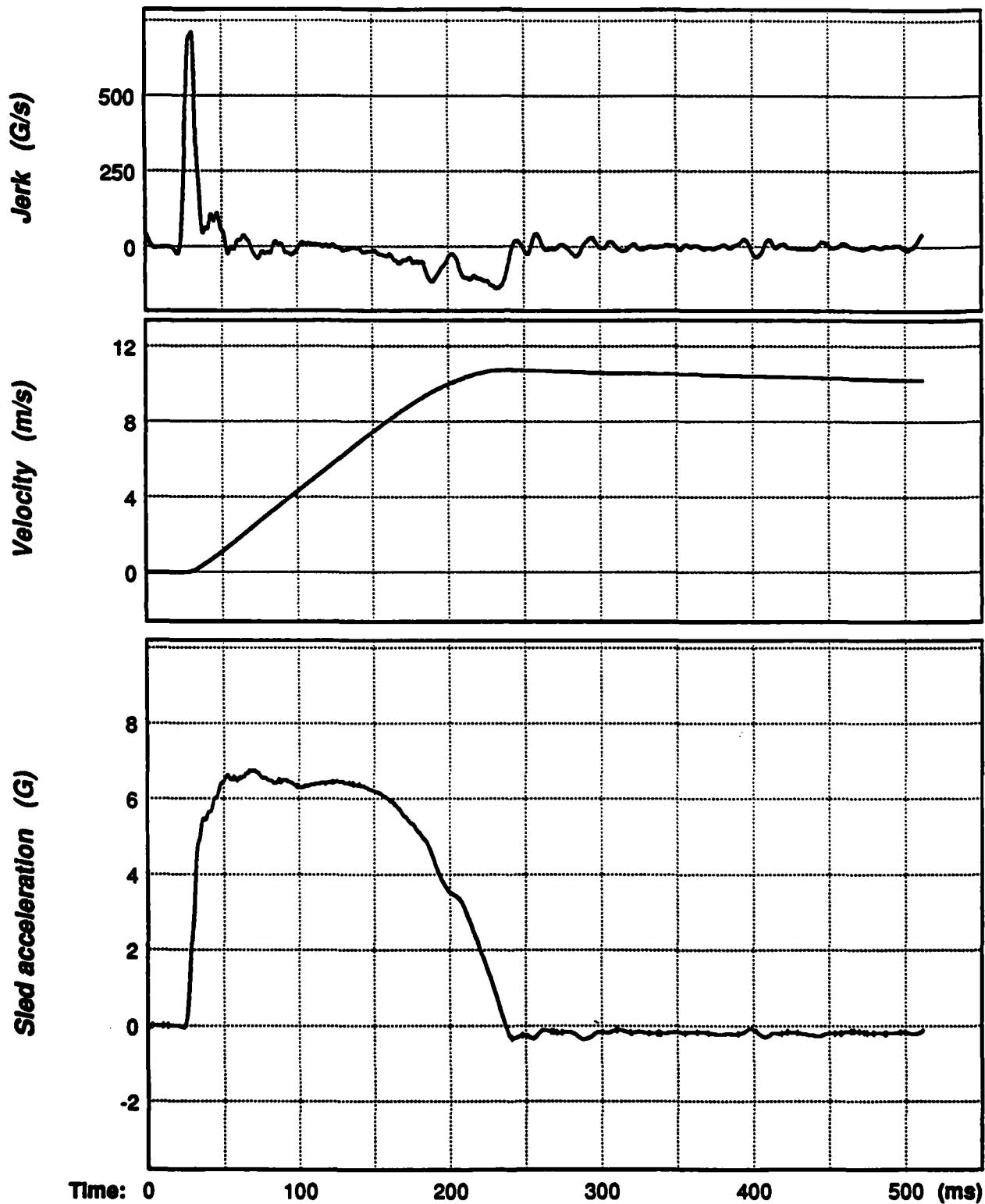


Figure B-7. Sled acceleration signal and its computed velocity and jerk for test LX6214.

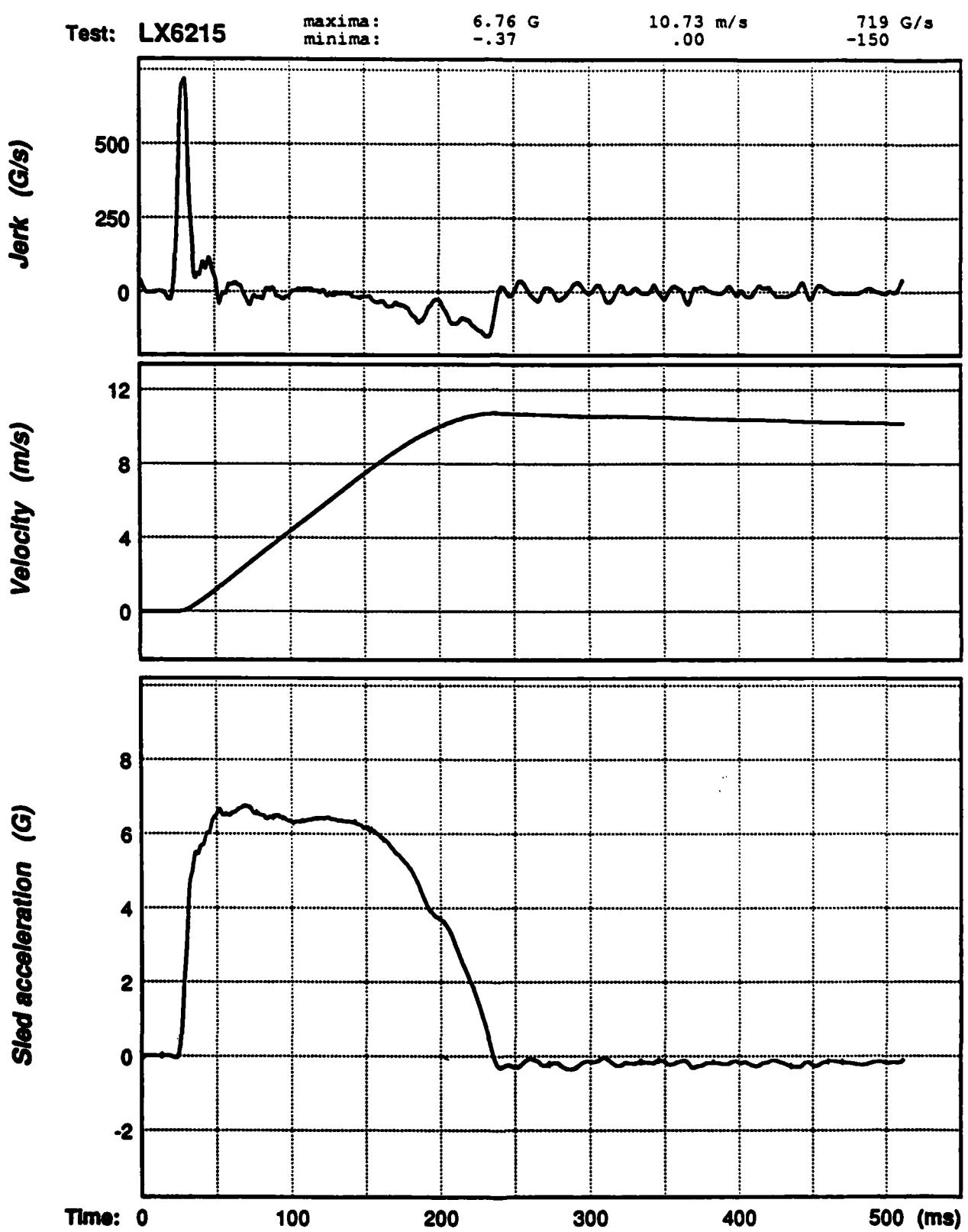


Figure B-8. Sled acceleration signal and its computed velocity and jerk for test LX6215.

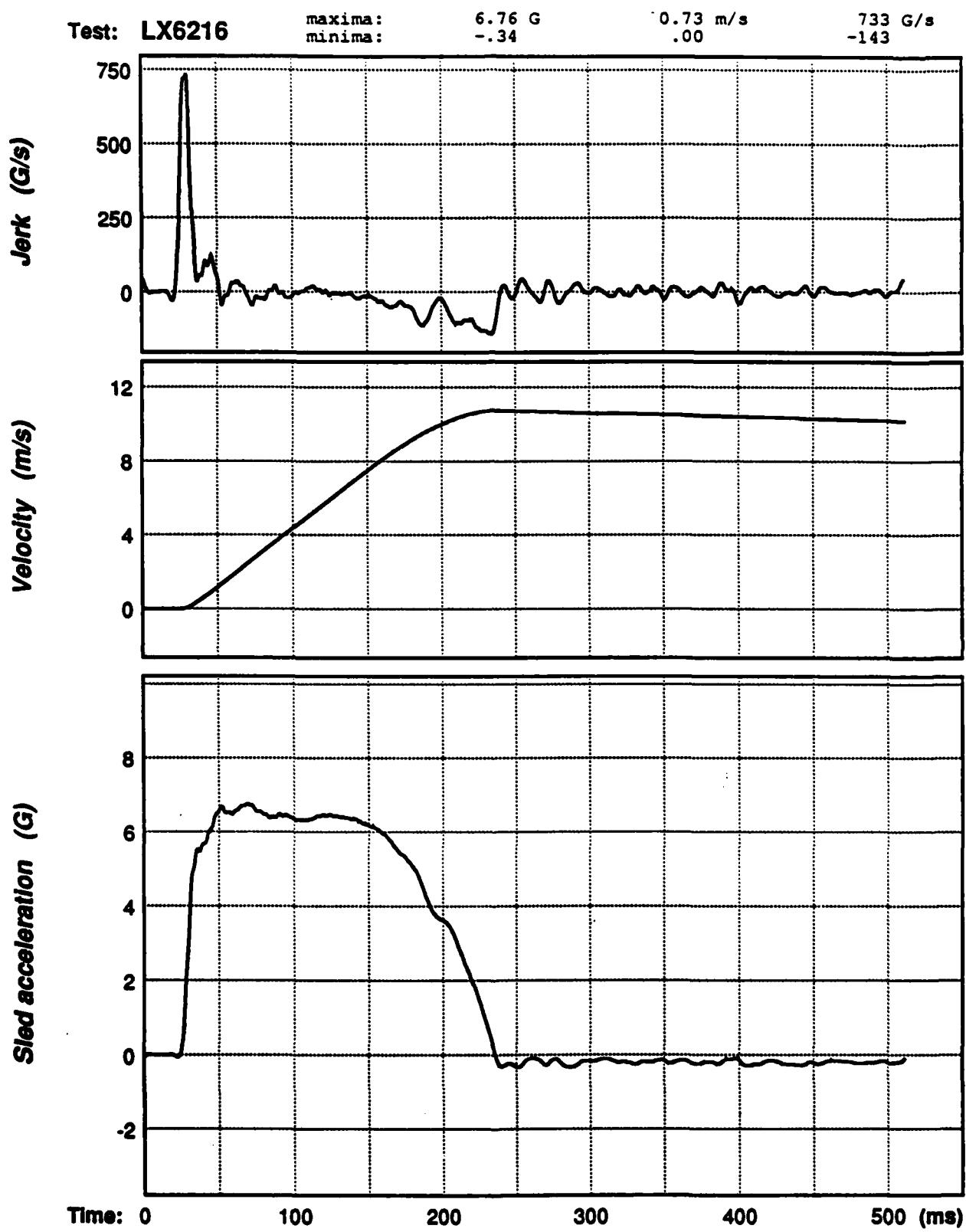


Figure B-9. Sled acceleration signal and its computed velocity and jerk for test LX6216.

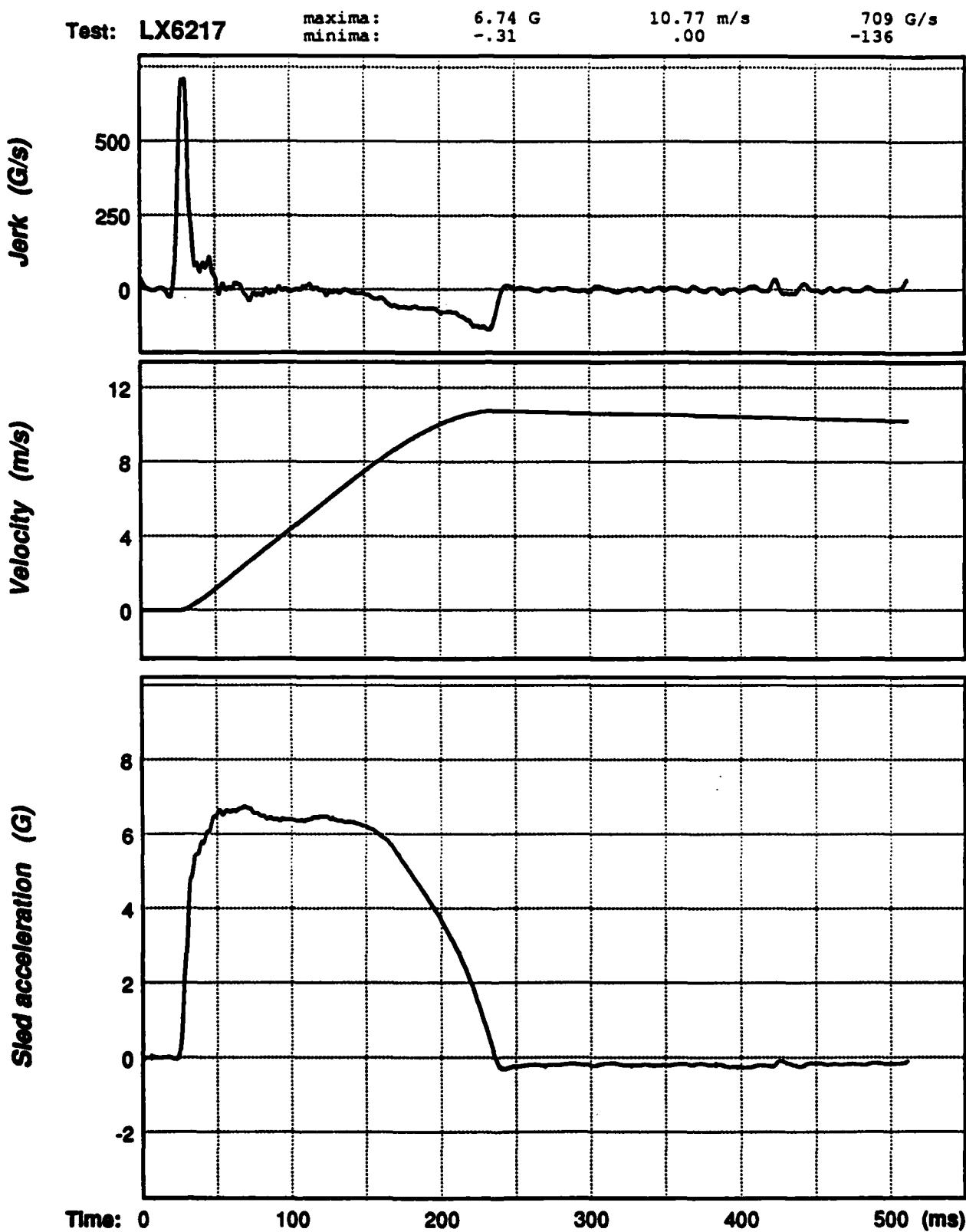


Figure B-10. Sled acceleration signal and its computed velocity and jerk for test LX6217.

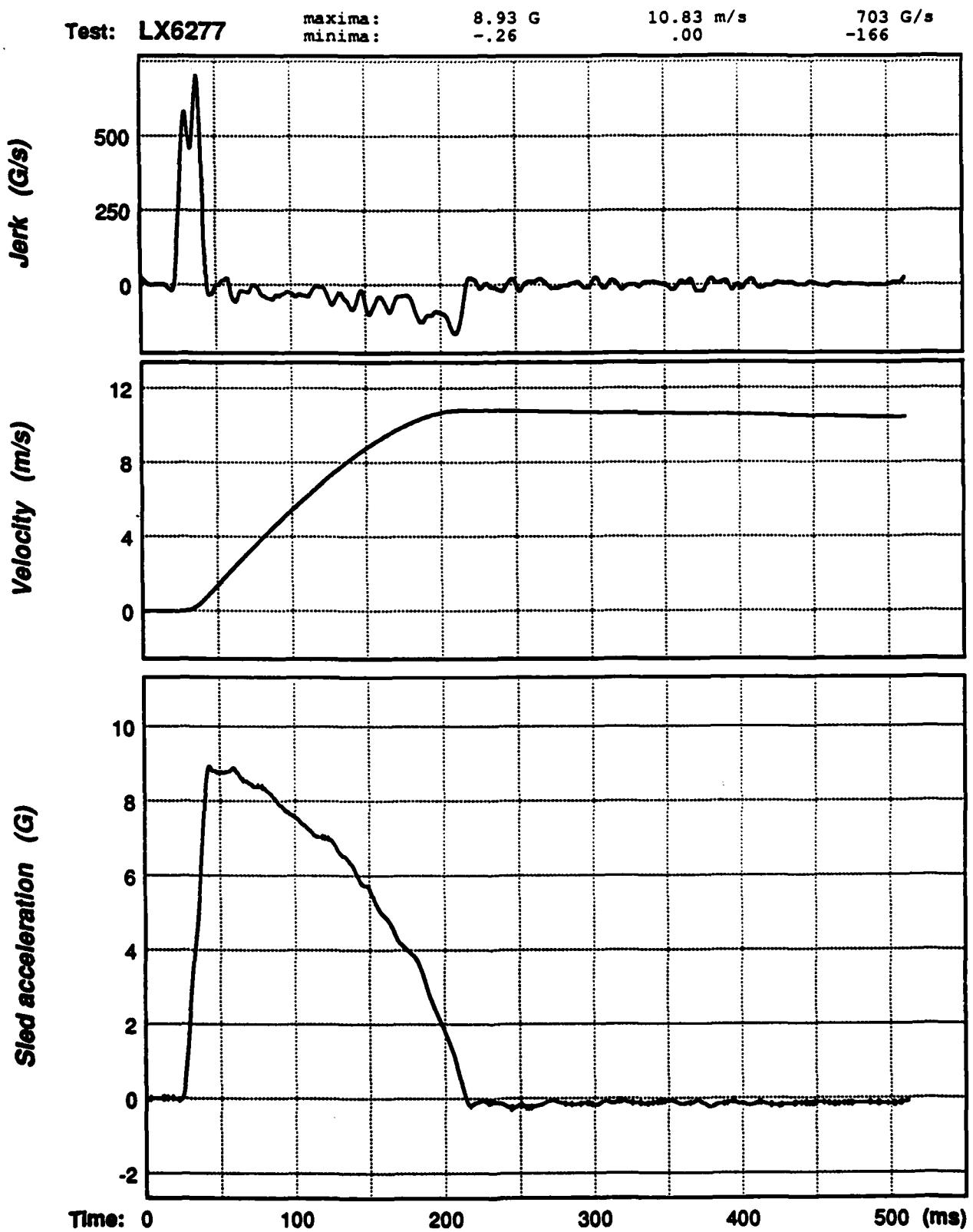


Figure B-11. Sled acceleration signal and its computed velocity and jerk for test LX6277.

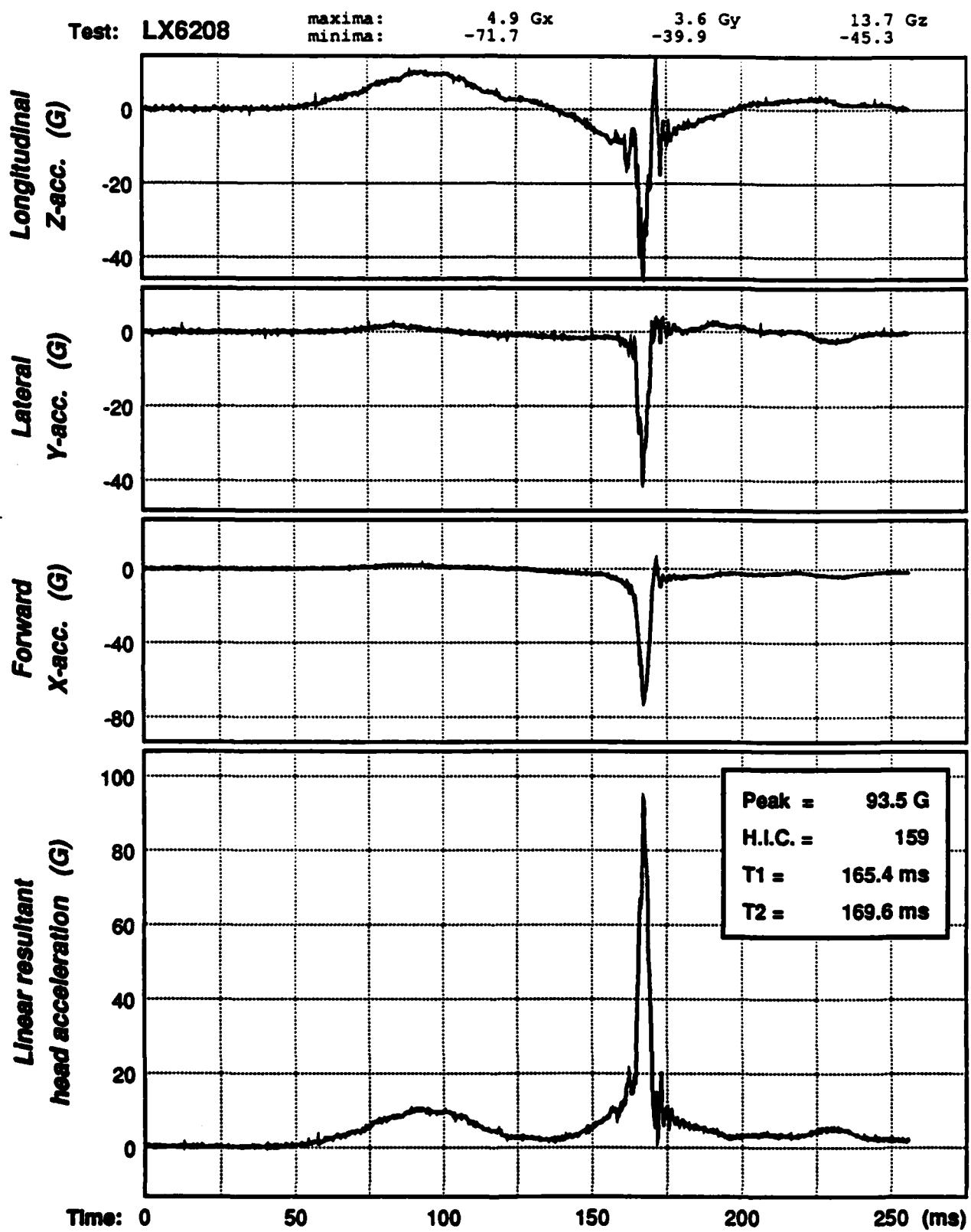


Figure B-12. Three components and resultant of the linear head acceleration for test LX6208.

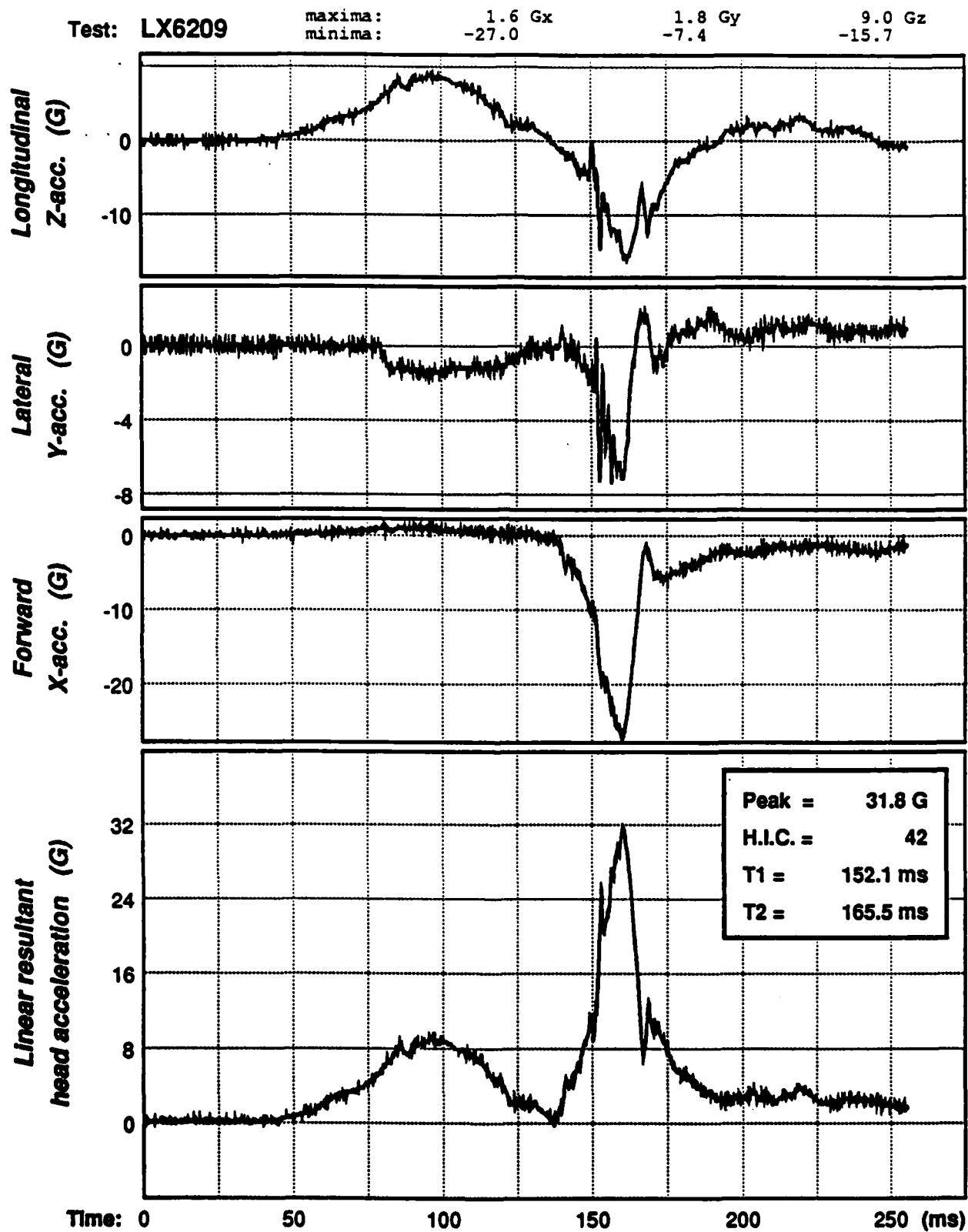


Figure B-13. Three components and resultant of the linear head acceleration for test LX6209.

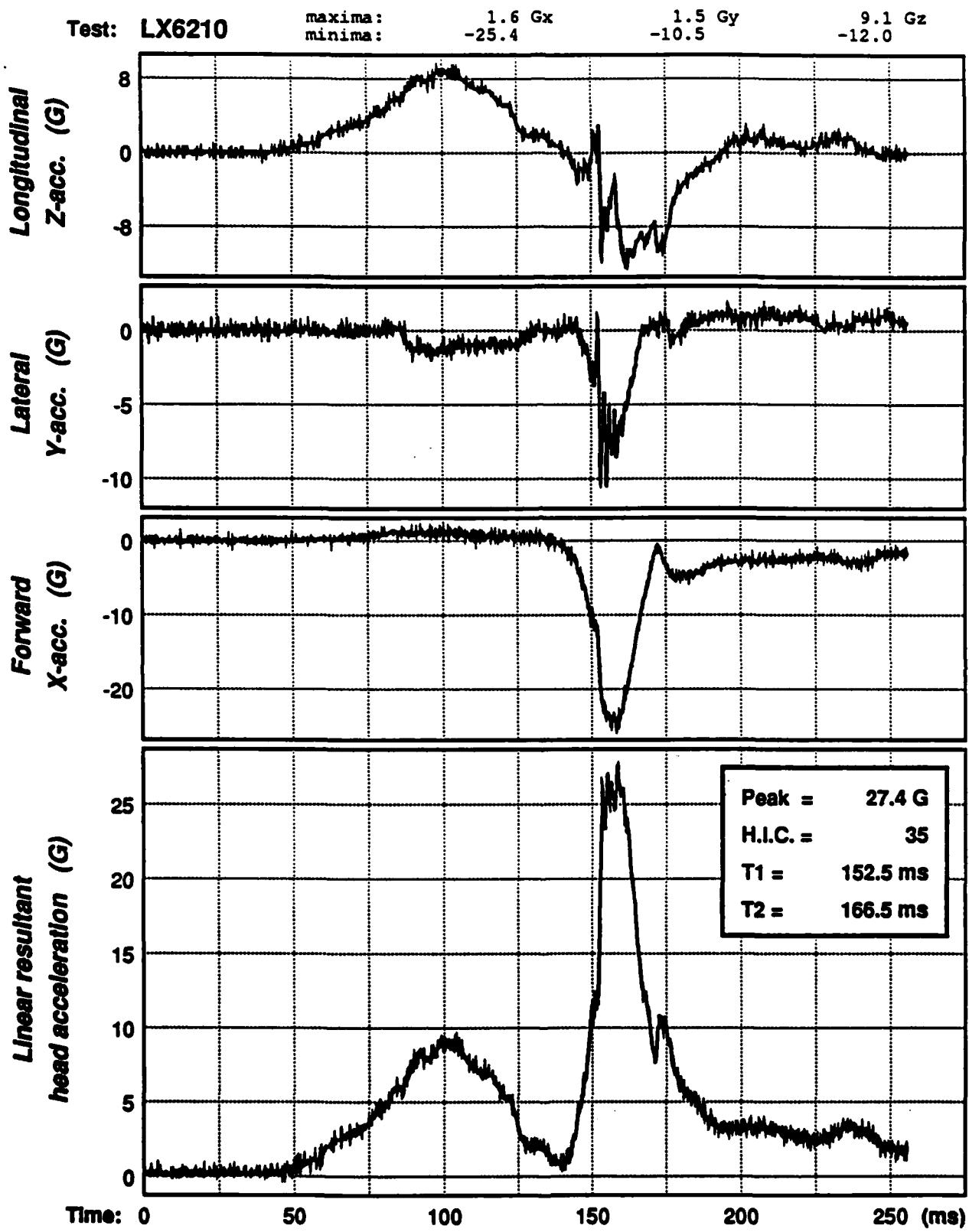


Figure B-14. Three components and resultant of the linear head acceleration for test LX6210.

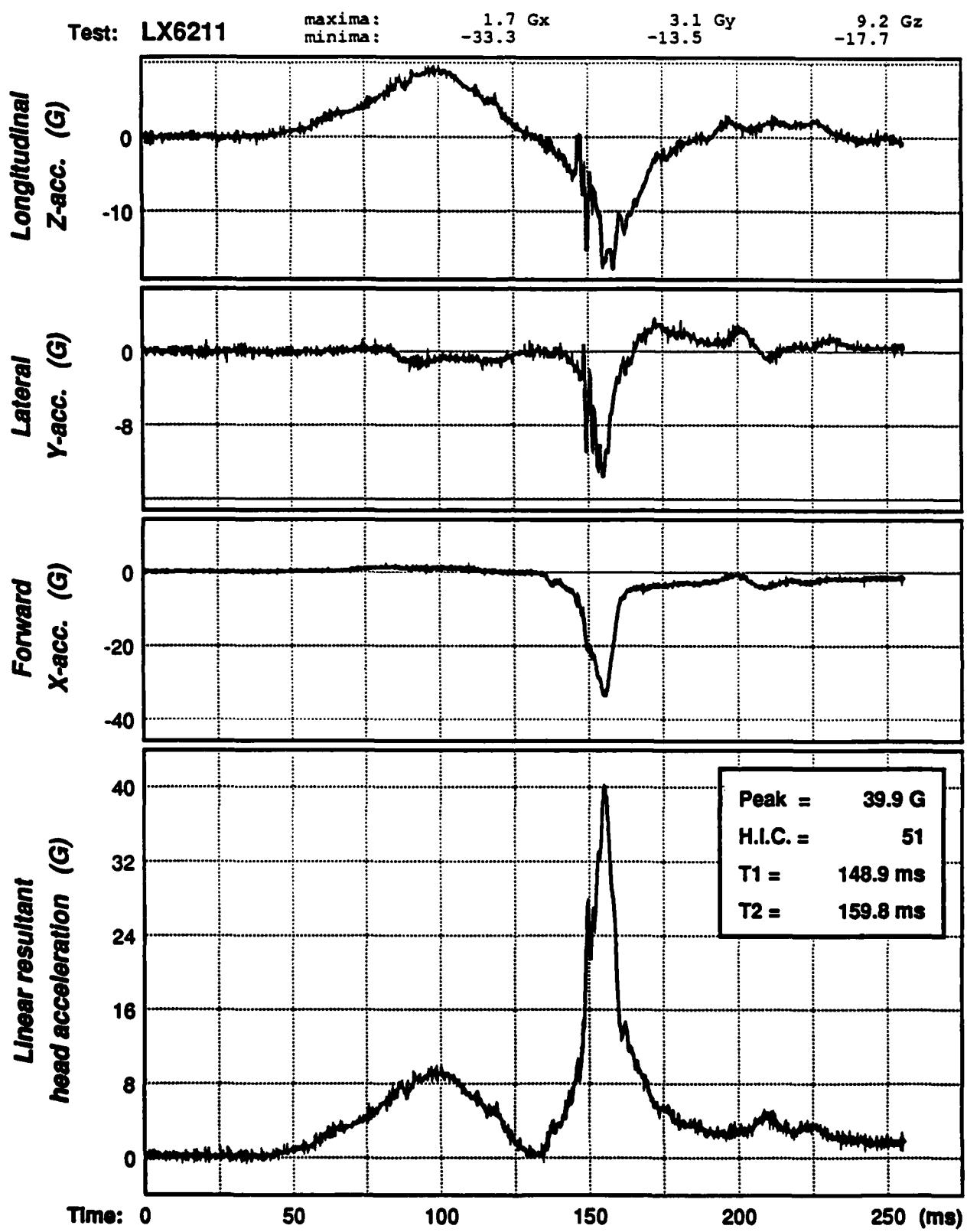


Figure B-15. Three components and resultant of the linear head acceleration for test LX6211.

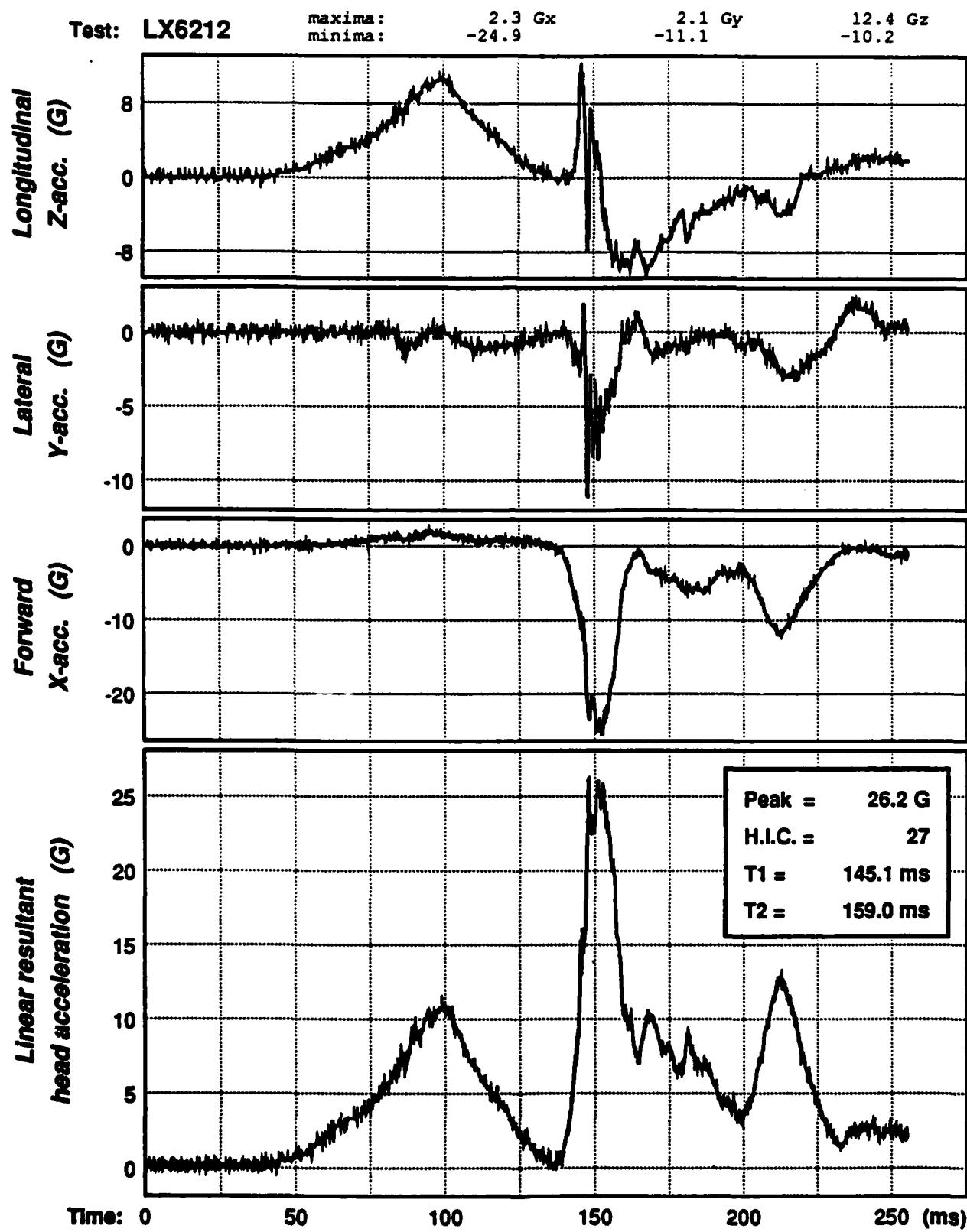


Figure B-16. Three components and resultant of the linear head acceleration for test LX6212.

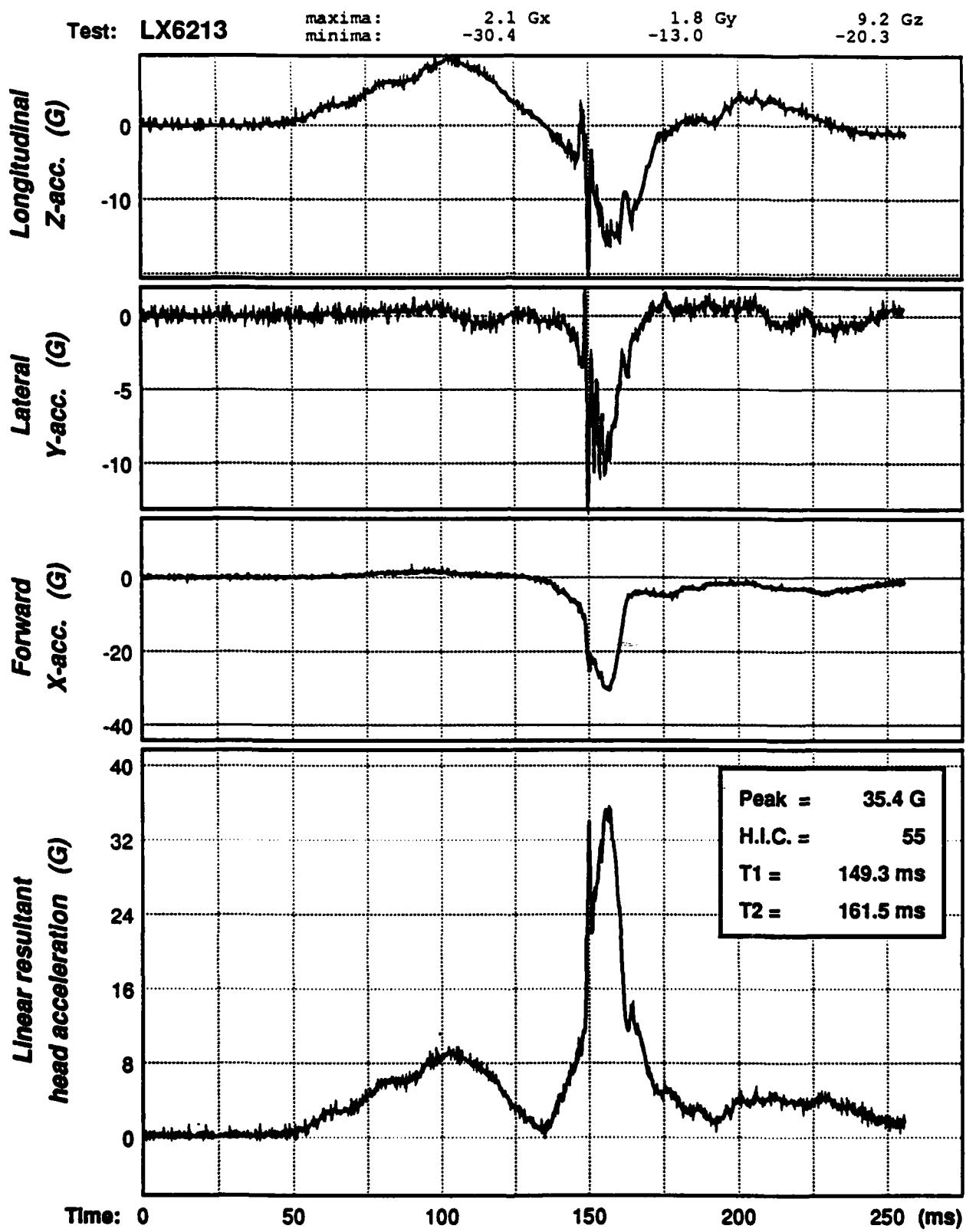


Figure B-17. Three components and resultant of the linear head acceleration for test LX6213.

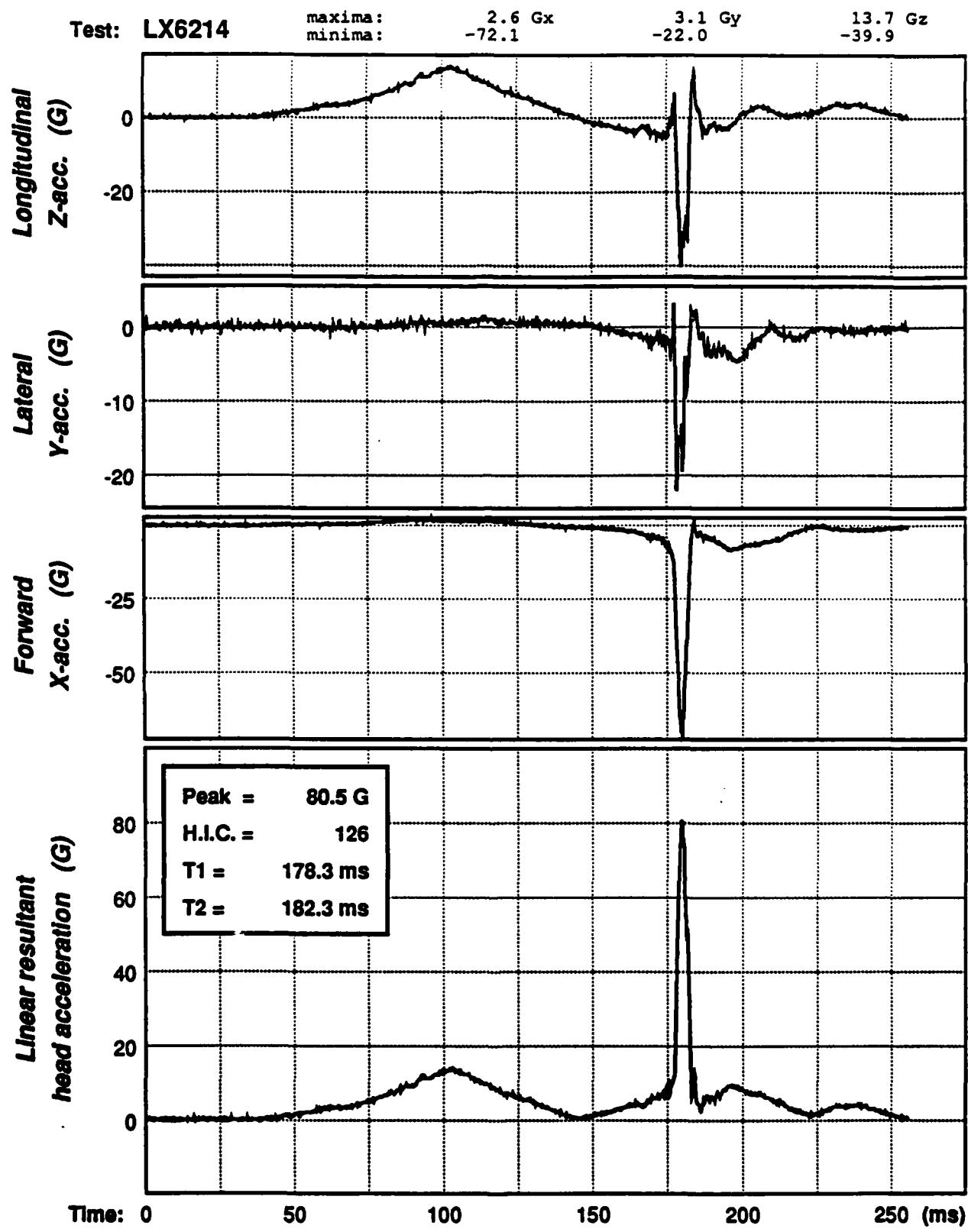


Figure B-18. Three components and resultant of the linear head acceleration for test LX6214.

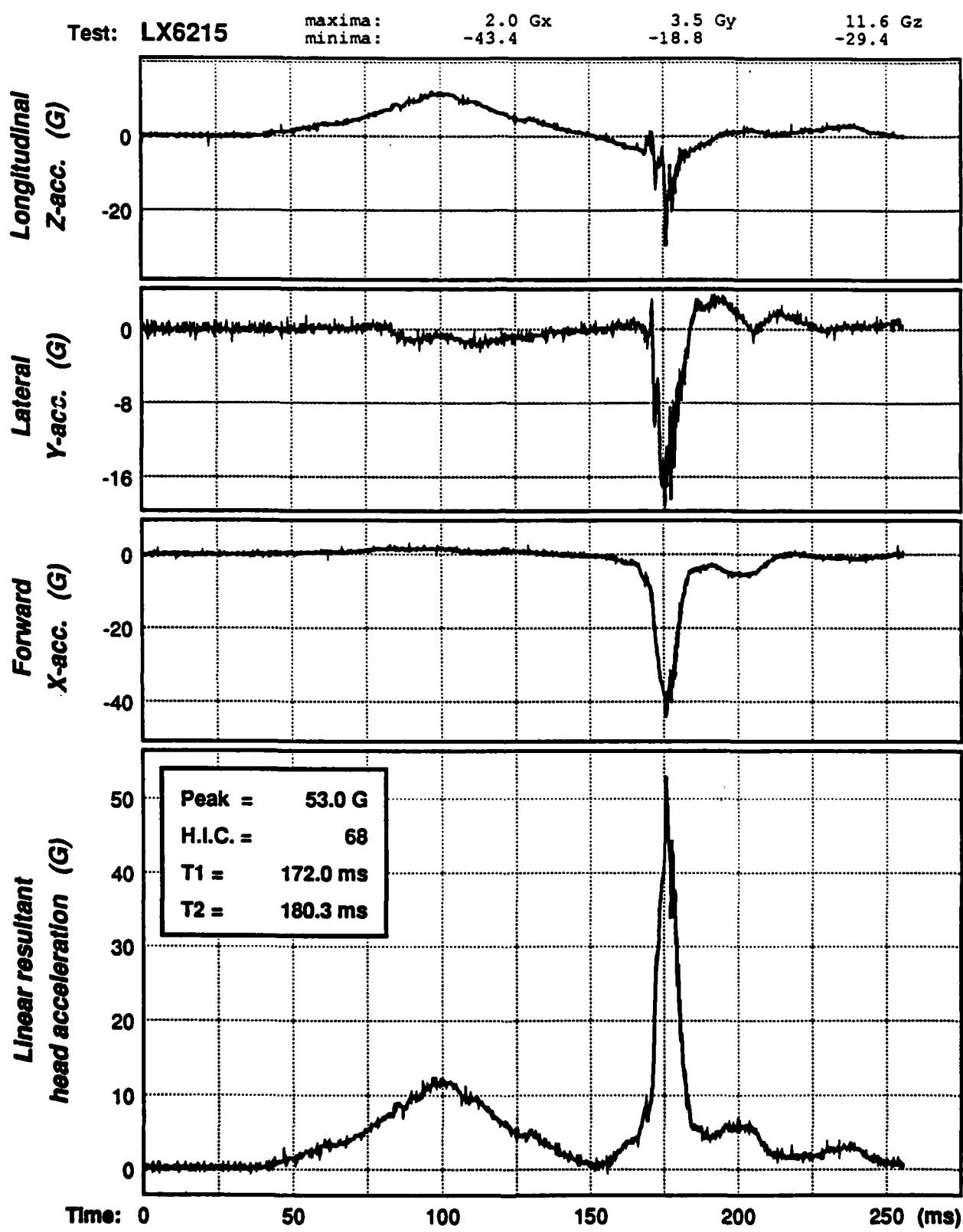


Figure B-19. Three components and resultant of the linear head acceleration for test LX6215.

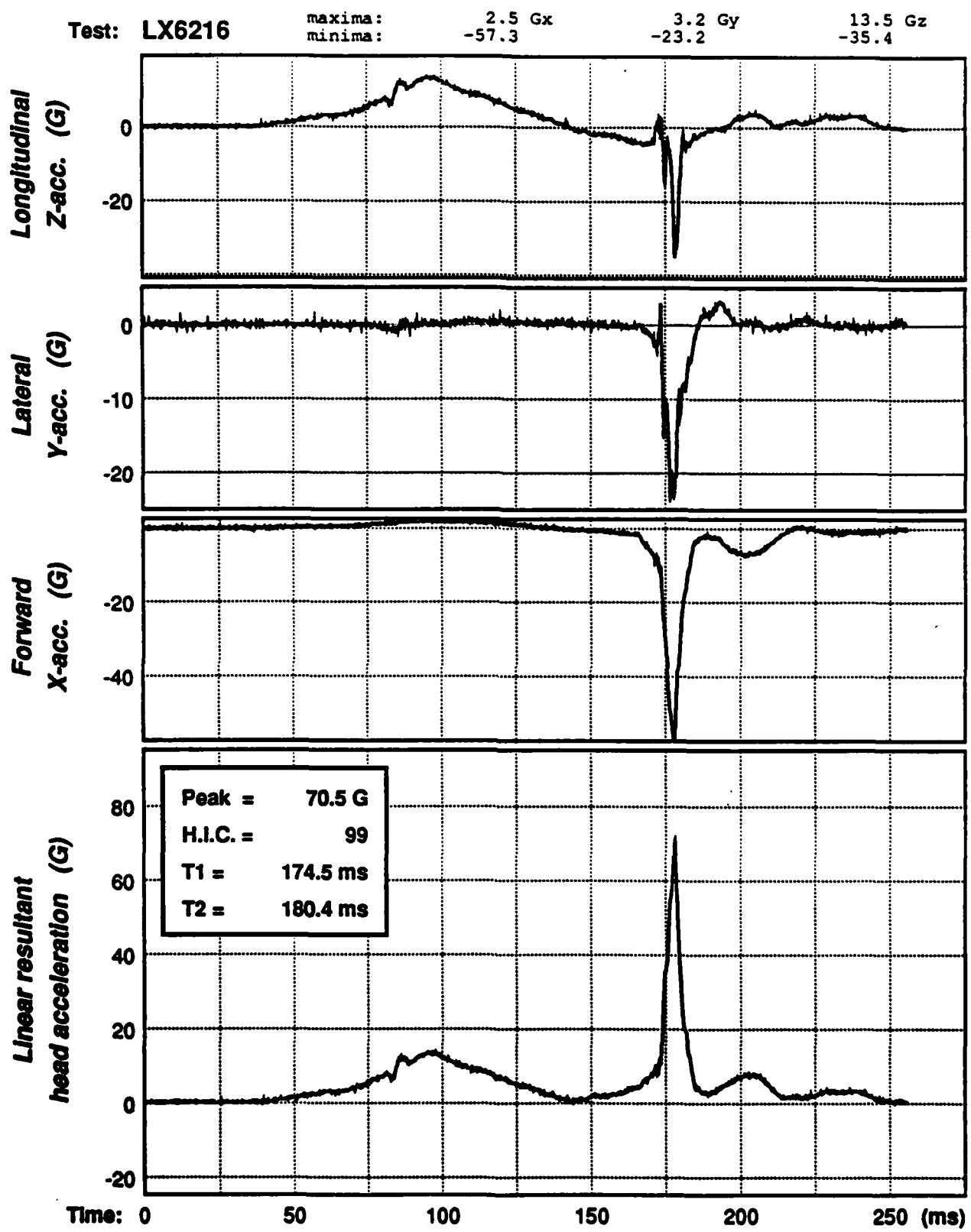


Figure B-20. Three components and resultant of the linear head acceleration for test LX6216.

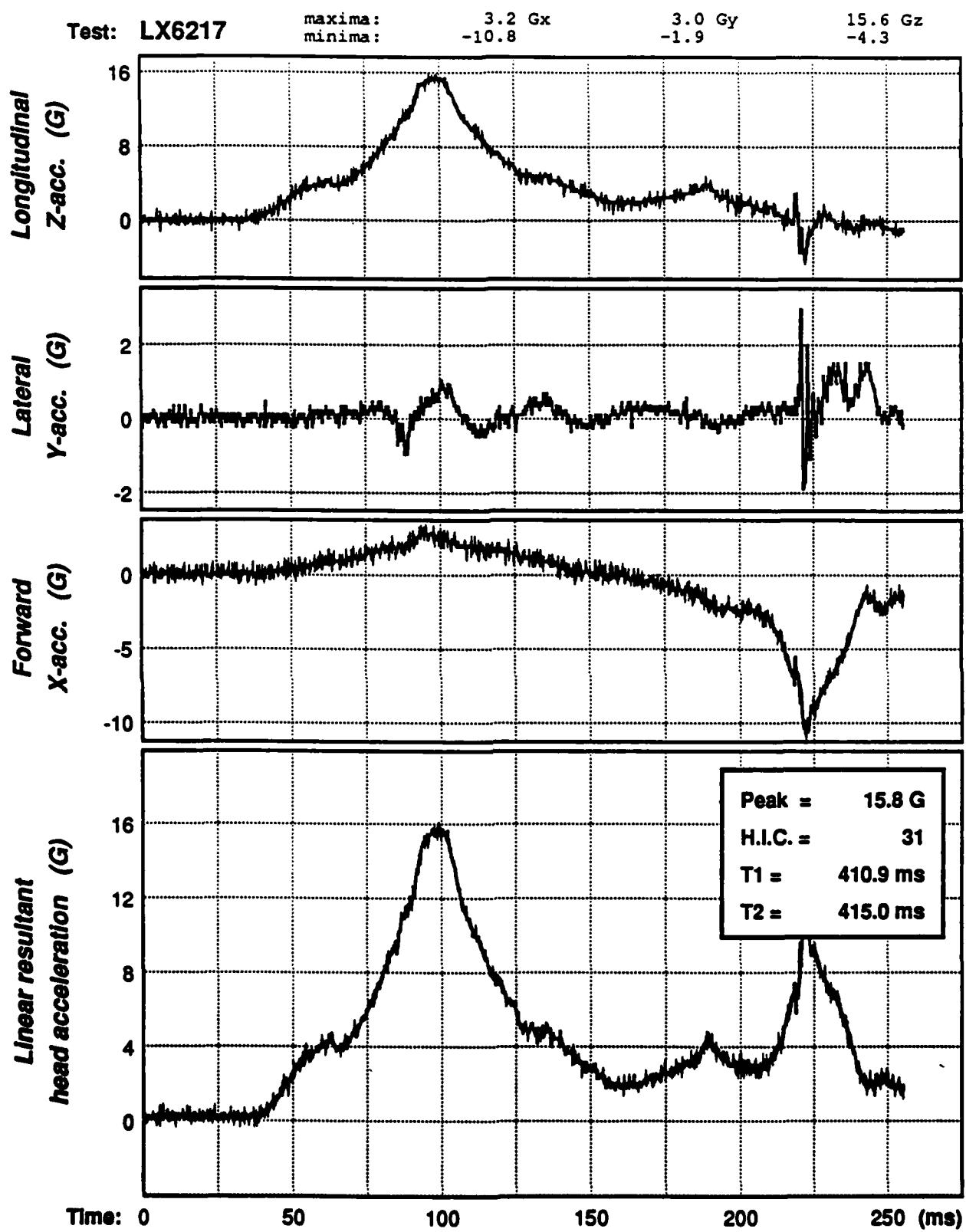


Figure B-21. Three components and resultant of the linear head acceleration for test LX6217.

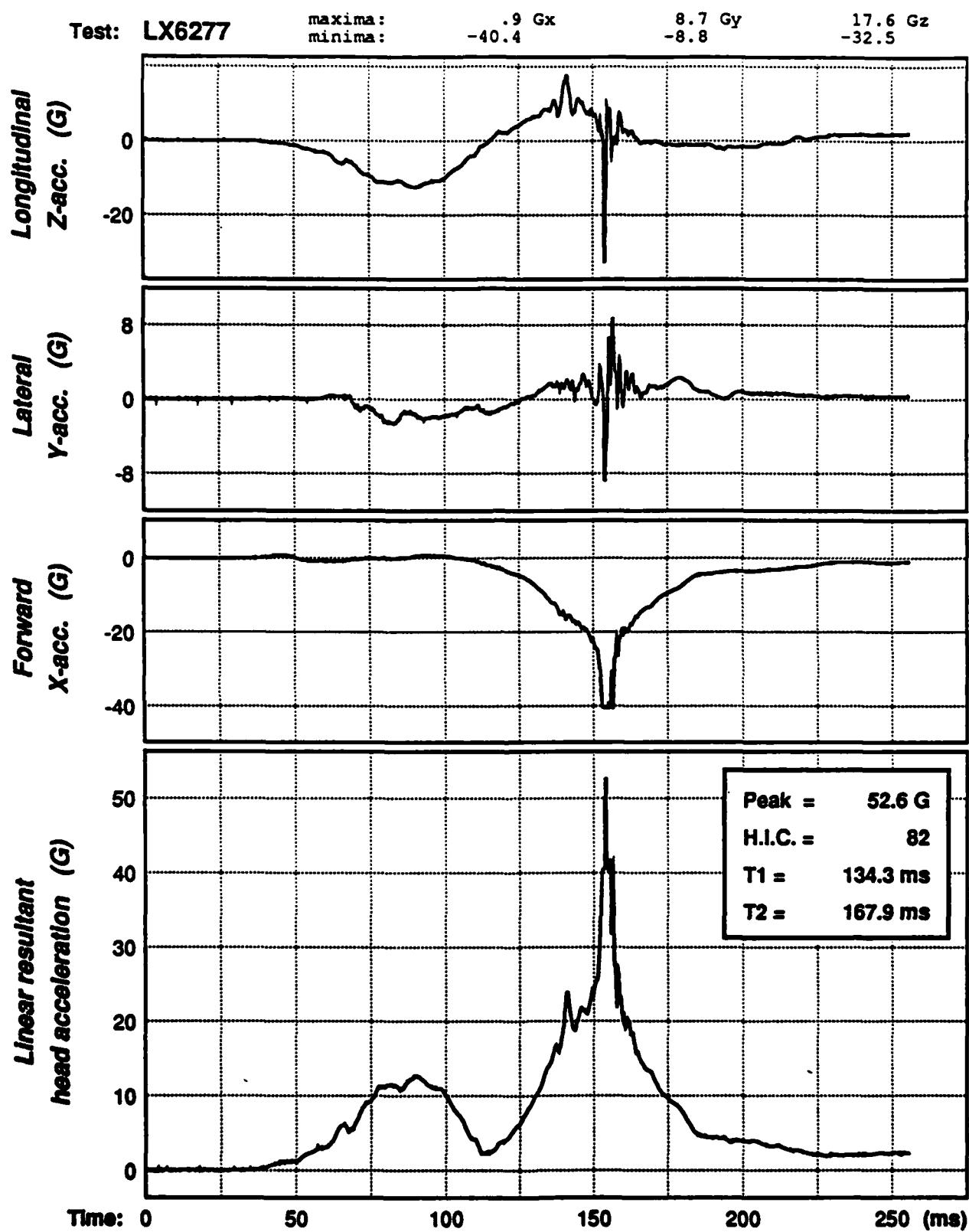


Figure B-22. Three components and resultant of the linear head acceleration for test LX6277.

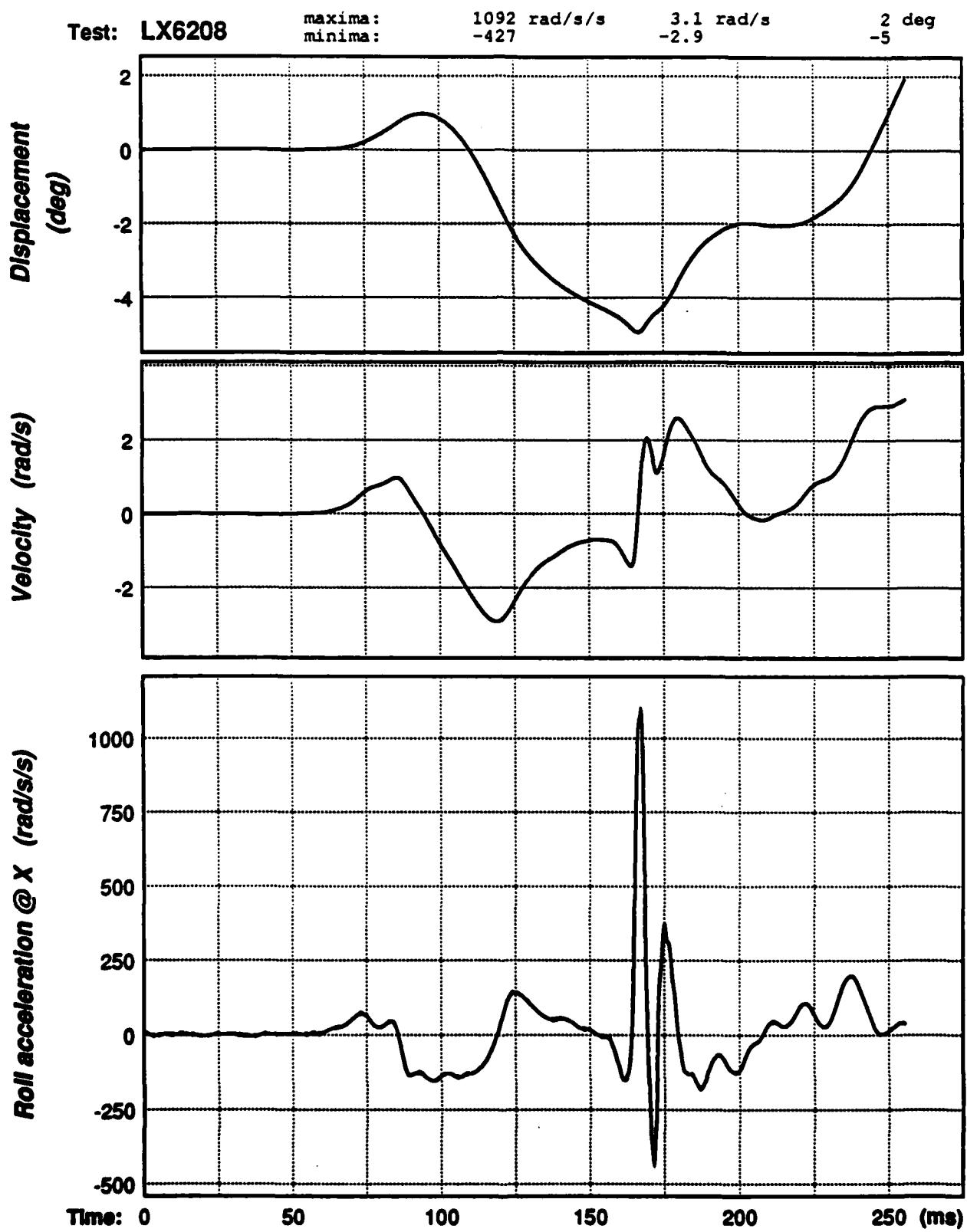


Figure B-23. Head roll angular acceleration, velocity, and displacement signals for test LX6208.

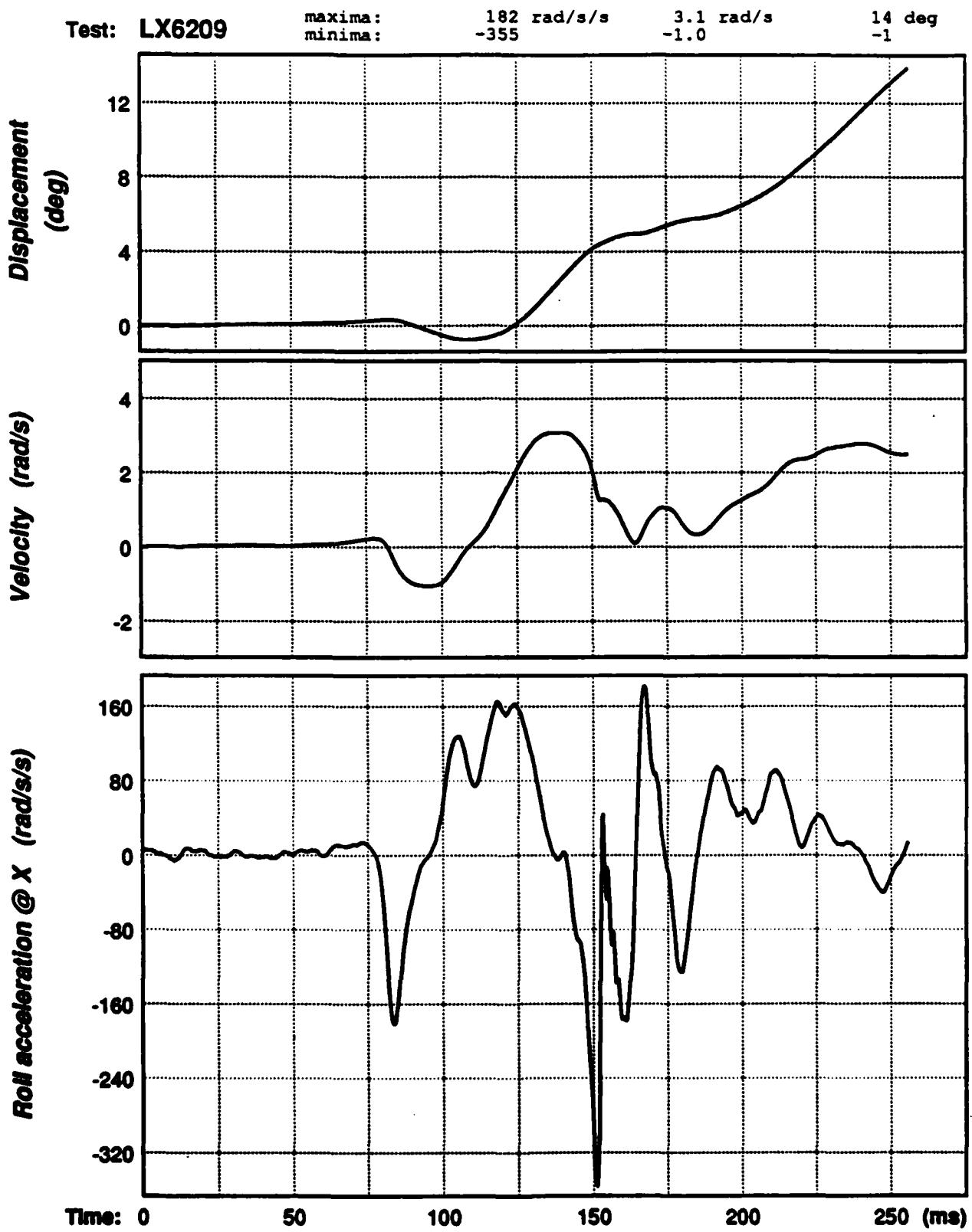


Figure B-24. Head roll angular acceleration, velocity, and displacement signals for test LX6209.

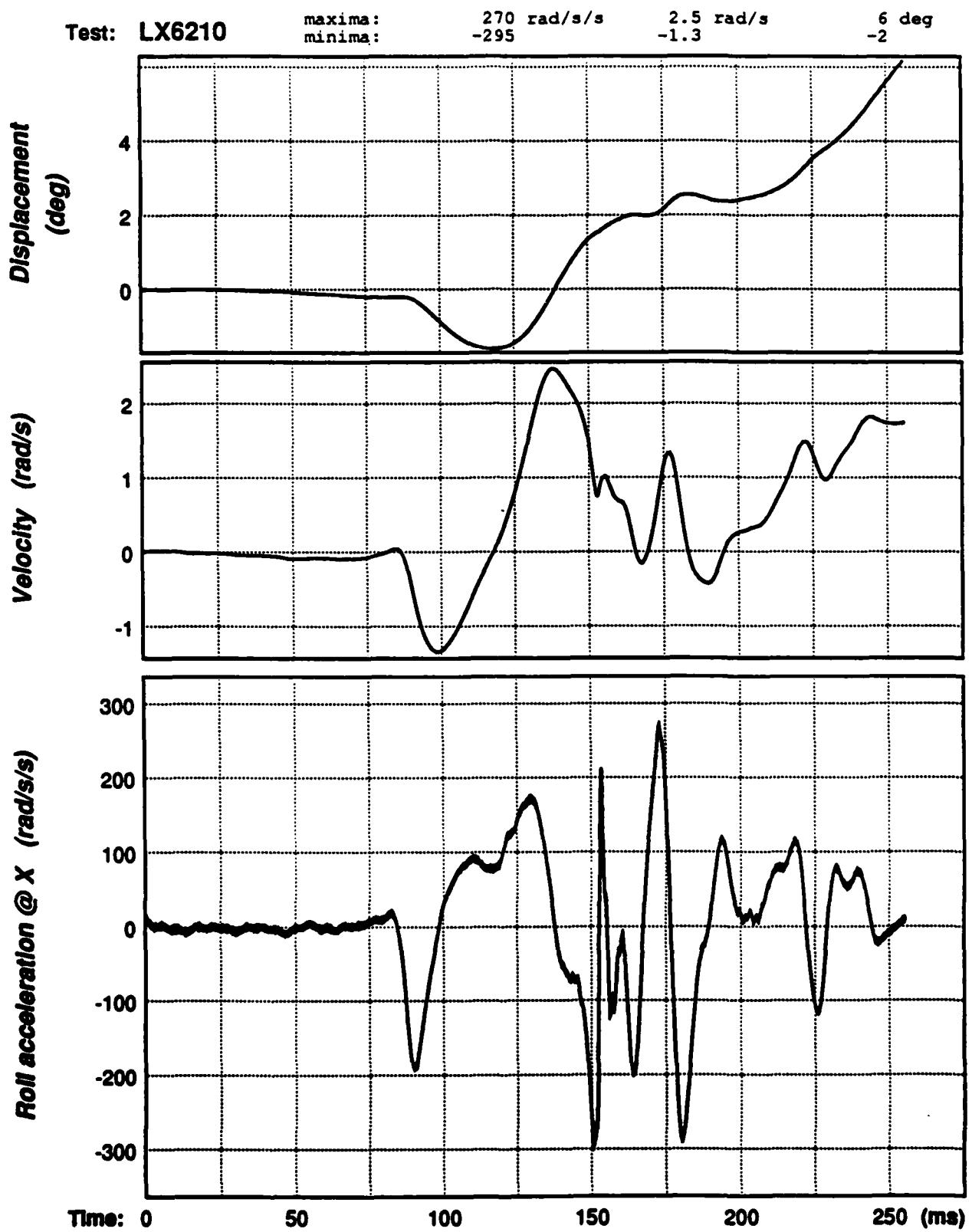


Figure B-25. Head roll angular acceleration, velocity, and displacement signals for test LX6210.

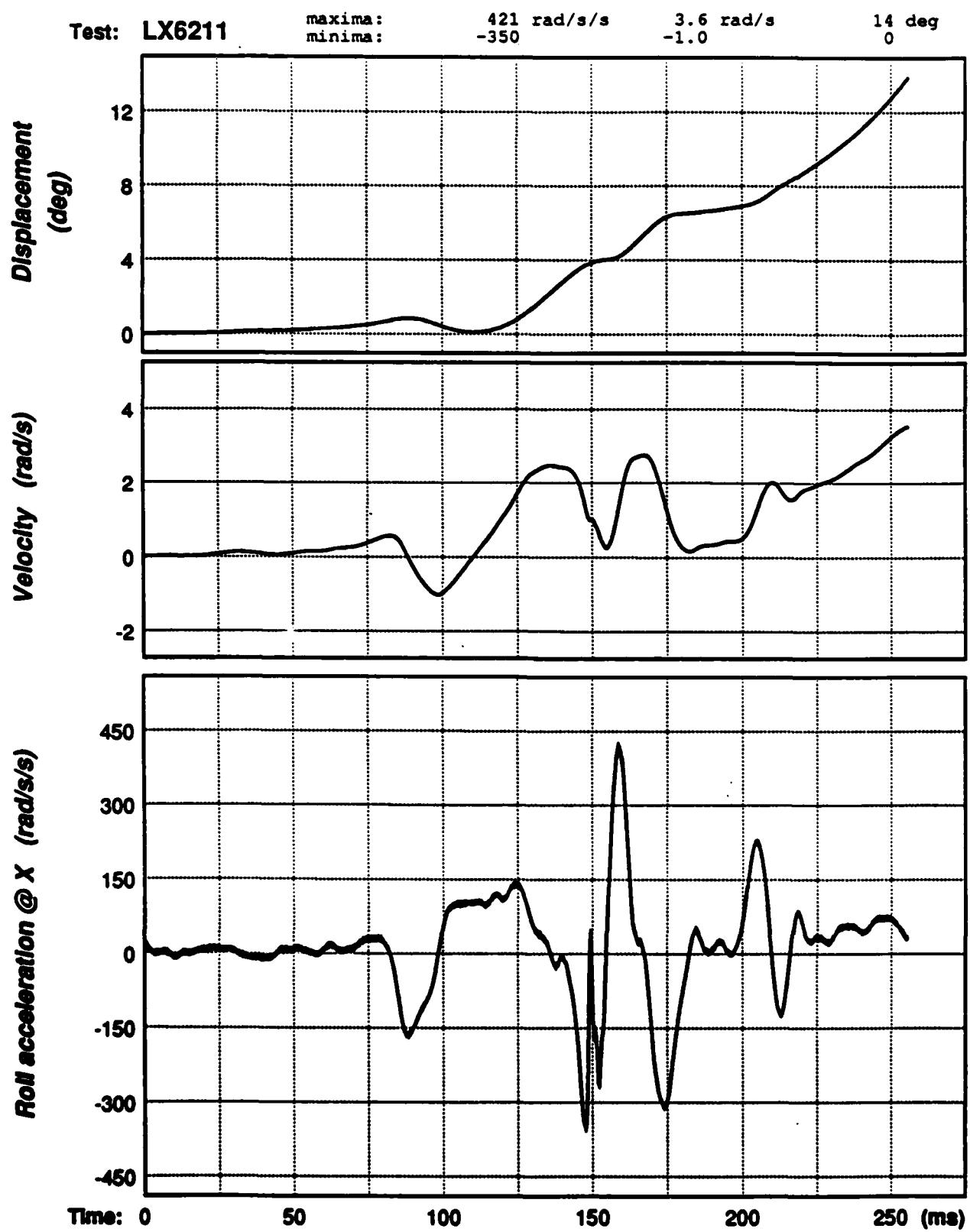


Figure B-26. Head roll angular acceleration, velocity, and displacement signals for test LX6211.

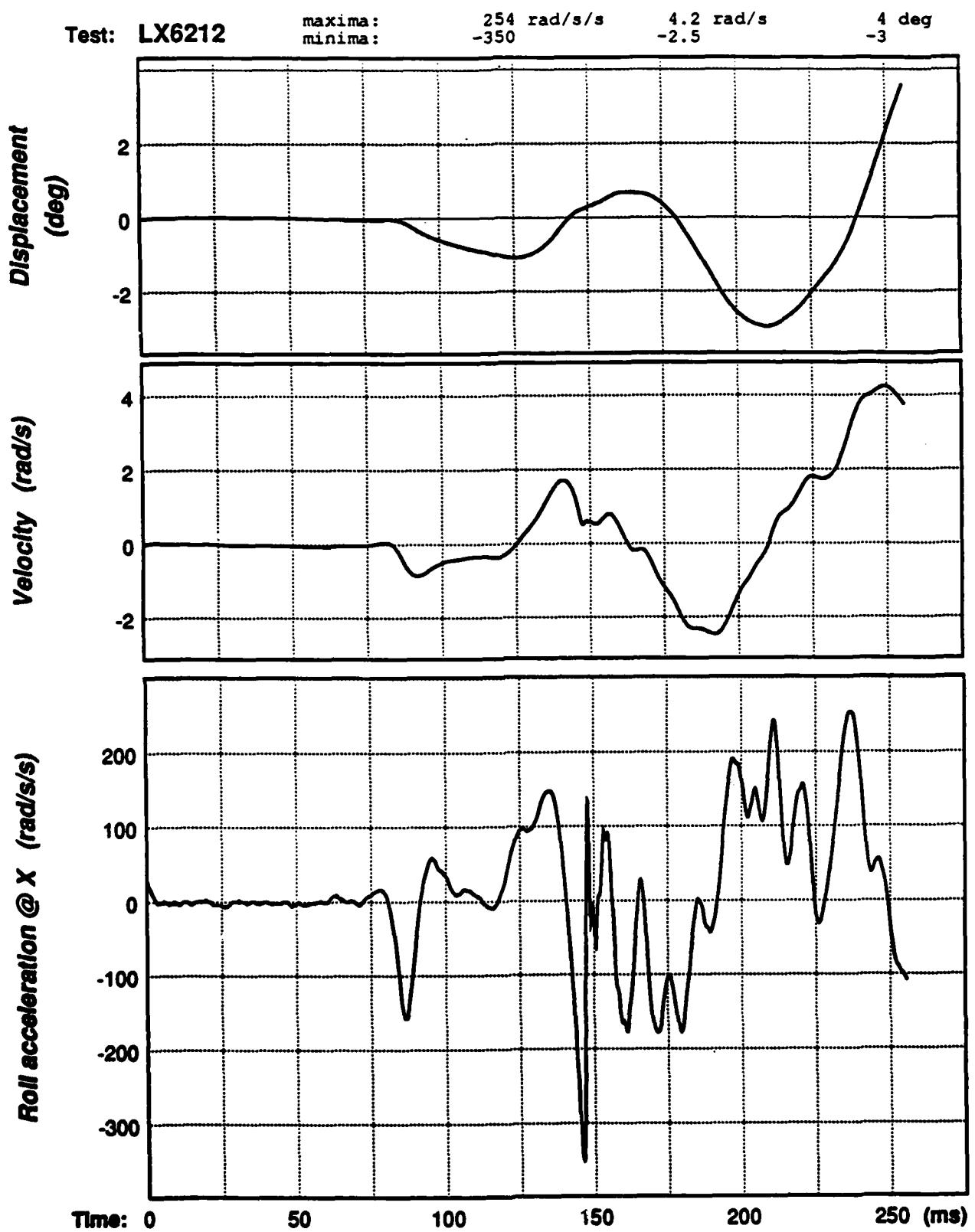


Figure B-27. Head roll angular acceleration, velocity, and displacement signals for test LX6212.

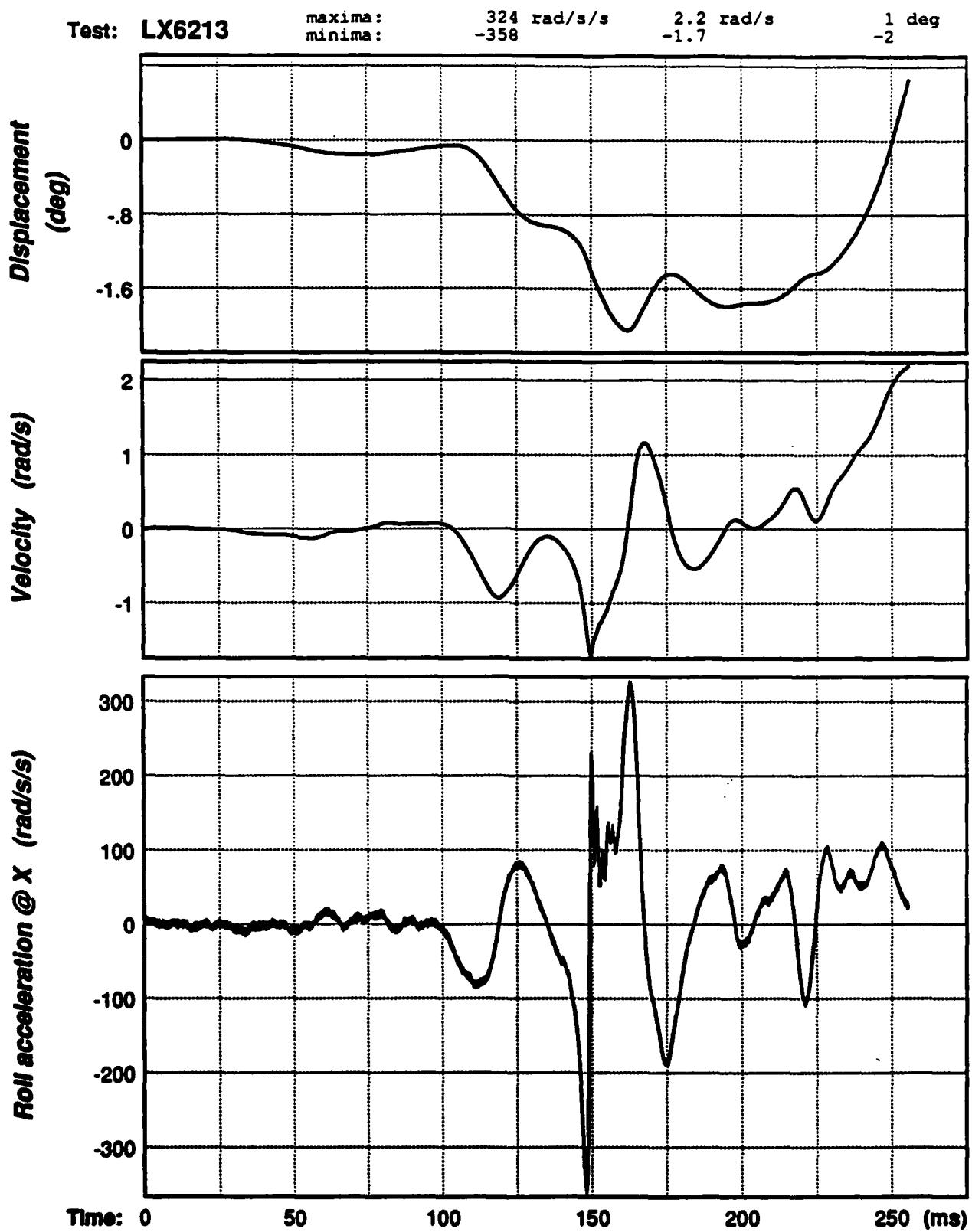


Figure B-28. Head roll angular acceleration, velocity, and displacement signals for test LX6213.

Test: LX6214 maxima: 595 rad/s/s 2.8 rad/s 5 deg
minima: -249 -2.8 -2

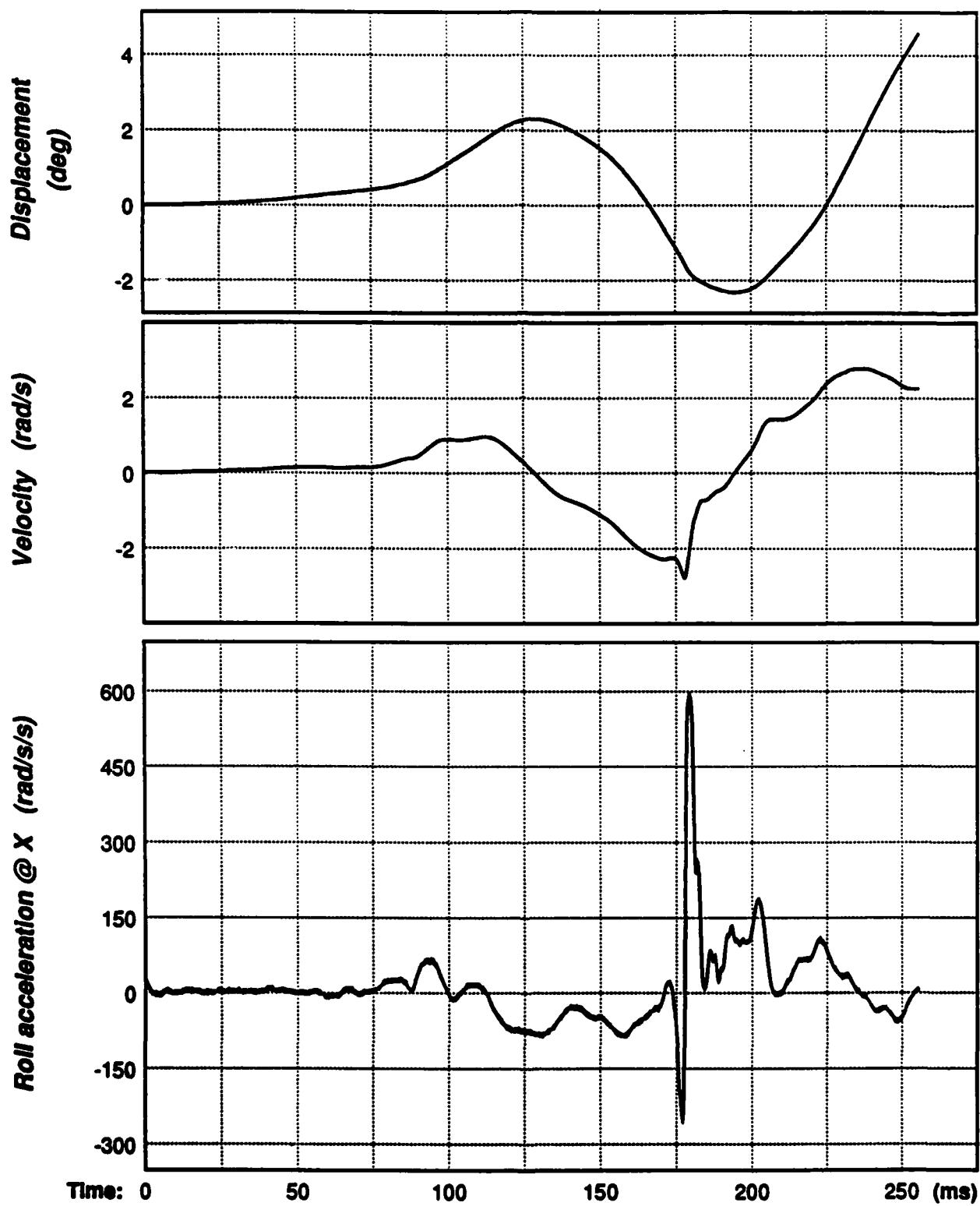


Figure B-29. Head roll angular acceleration, velocity, and displacement signals for test LX6214.

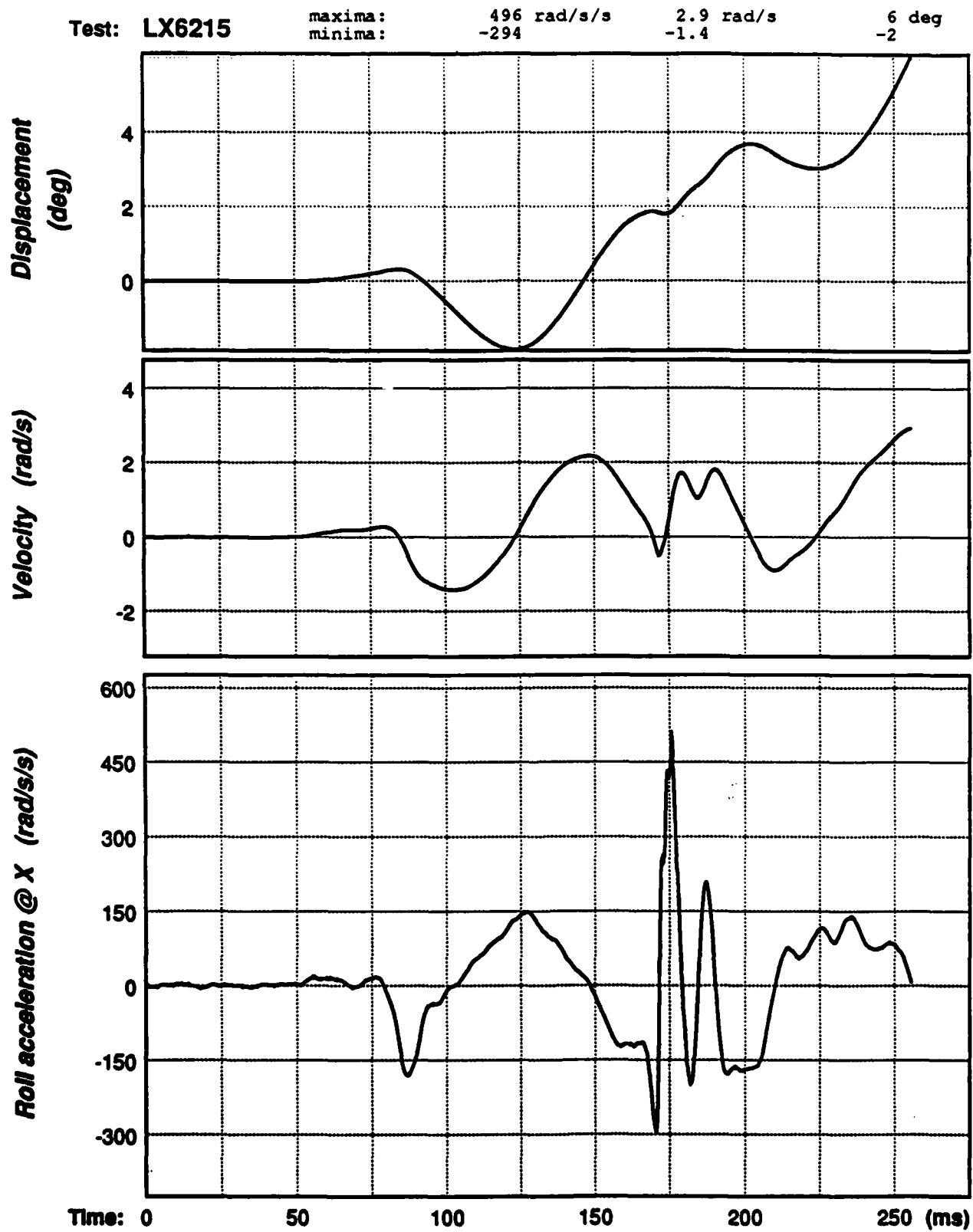


Figure B-30. Head roll angular acceleration, velocity, and displacement signals for test LX6215.

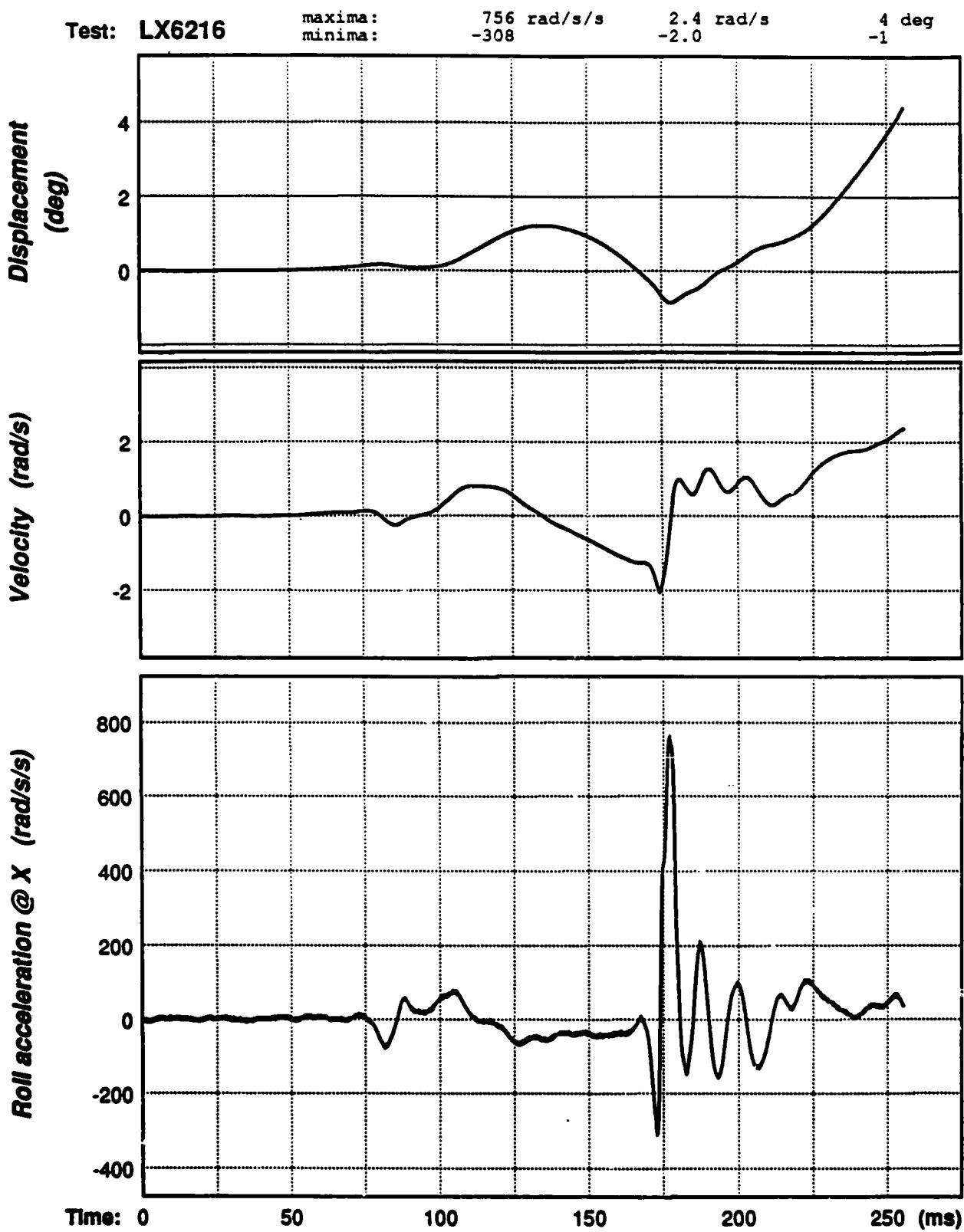


Figure B-31. Head roll angular acceleration, velocity, and displacement signals for test LX6216.

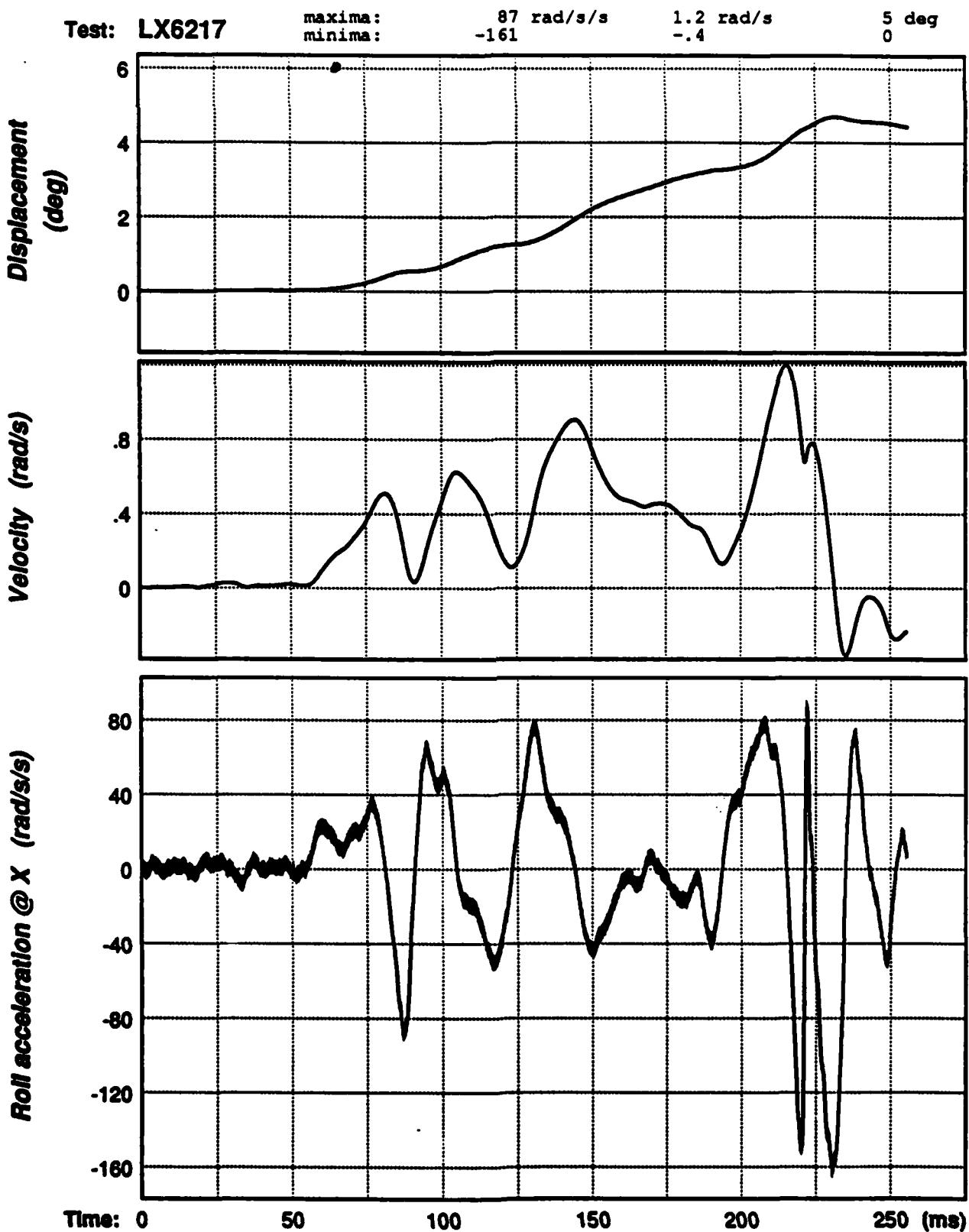


Figure B-32. Head roll angular acceleration, velocity, and displacement signals for test LX6217.

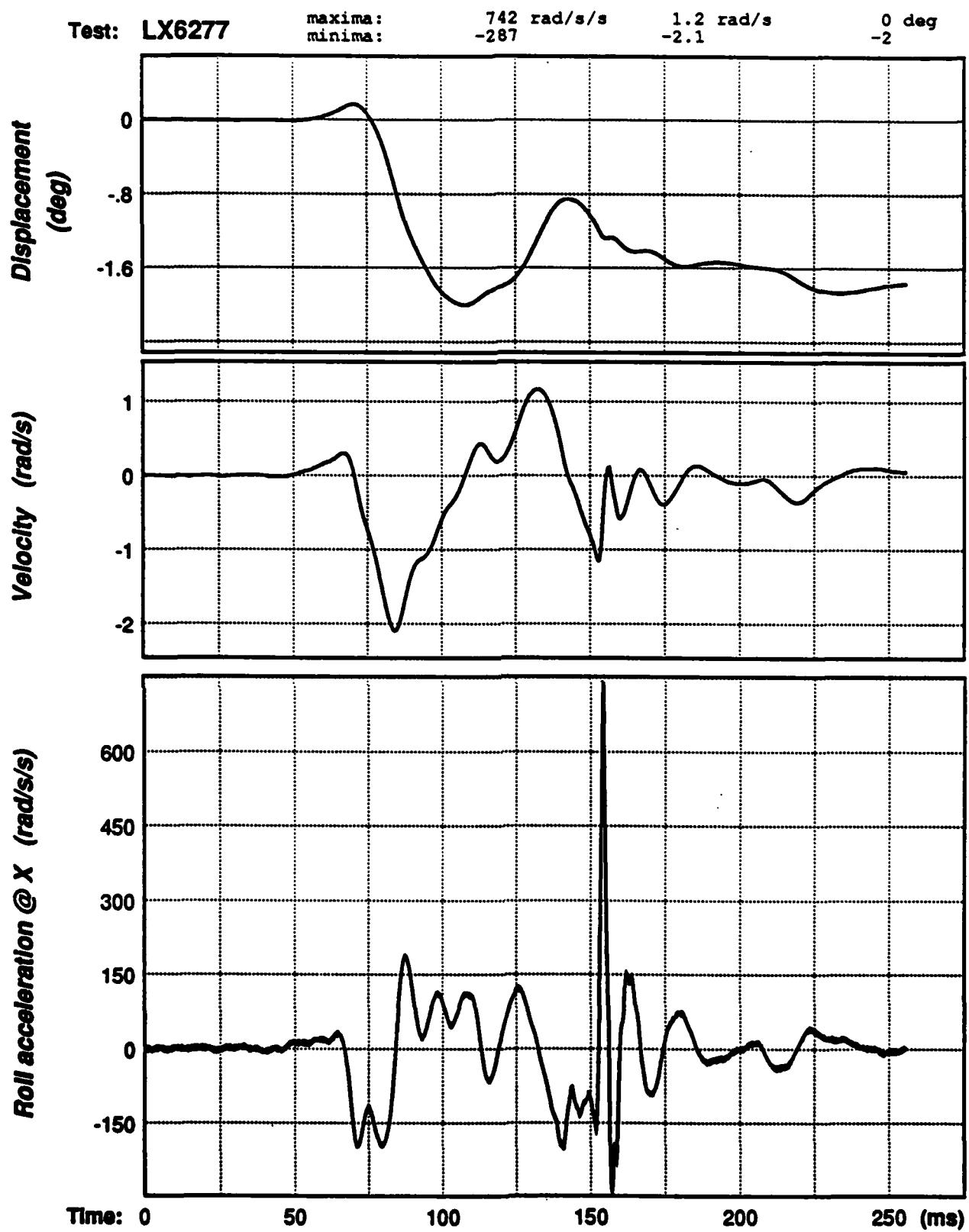


Figure B-33. Head roll angular acceleration, velocity, and displacement signals for test LX6277.

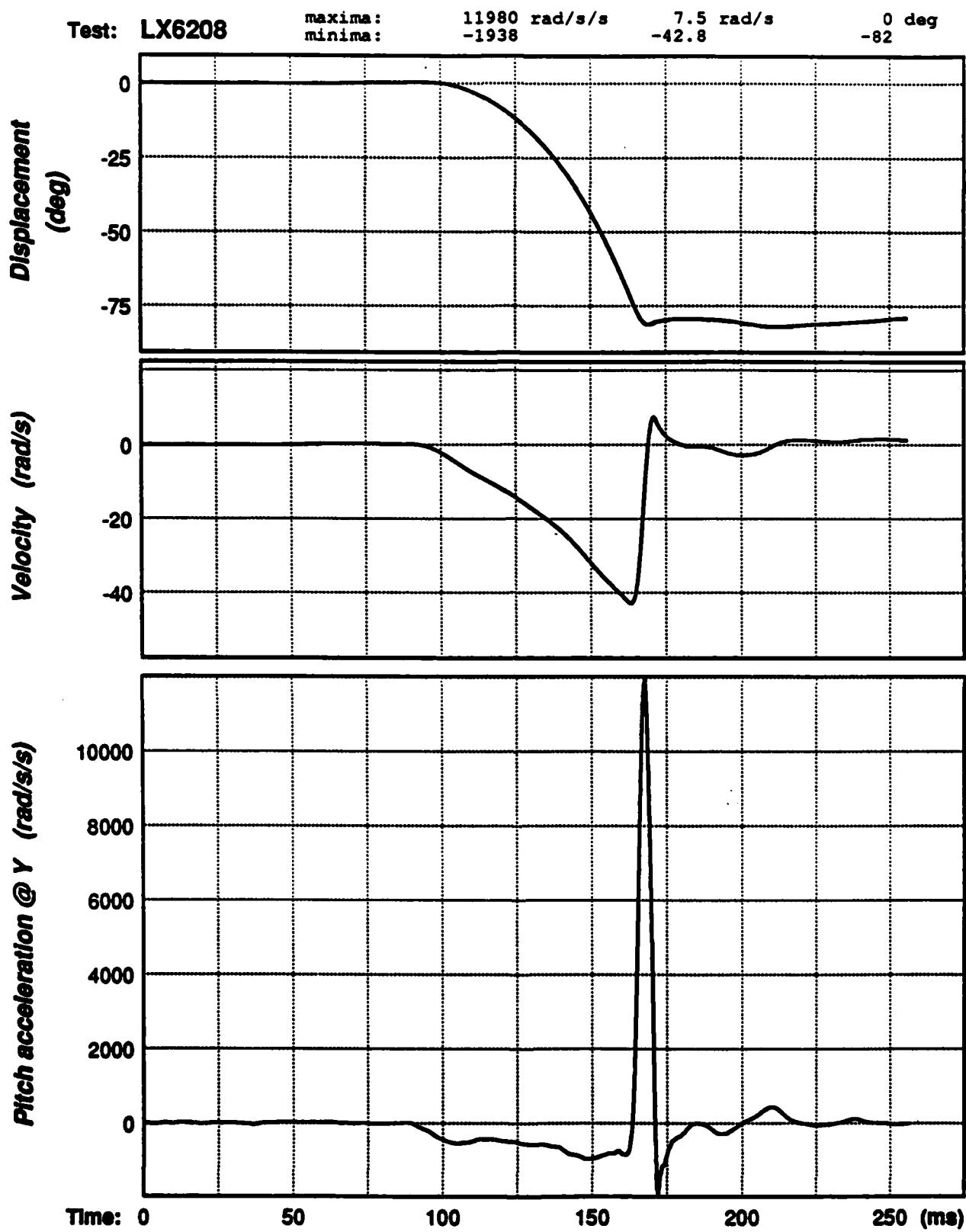


Figure B-34. Head pitch angular acceleration, velocity, and displacement signals for test LX6208.

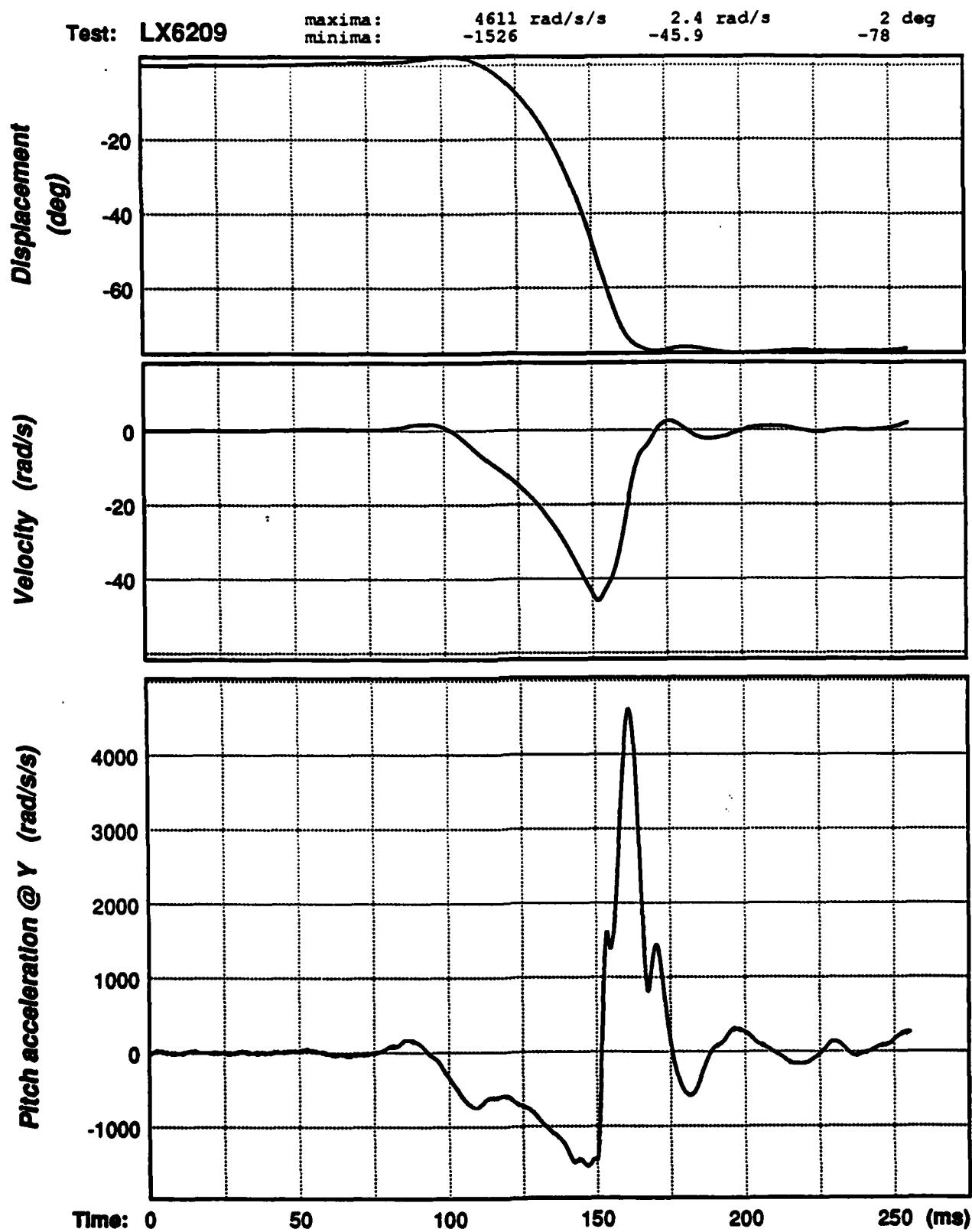


Figure B-35. Head pitch angular acceleration, velocity, and displacement signals for test LX6209.

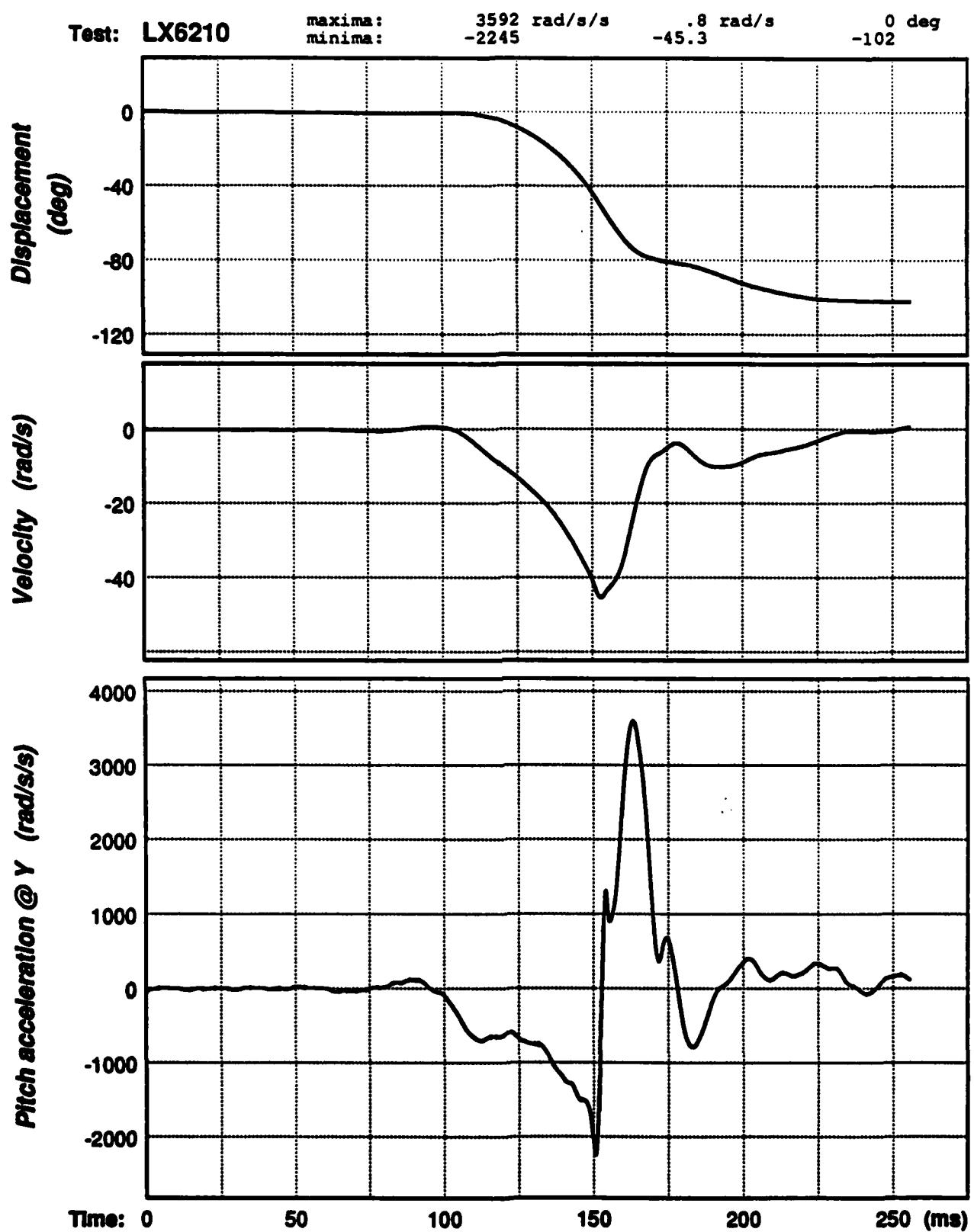


Figure B-36. Head pitch angular acceleration, velocity, and displacement signals for test LX6210.

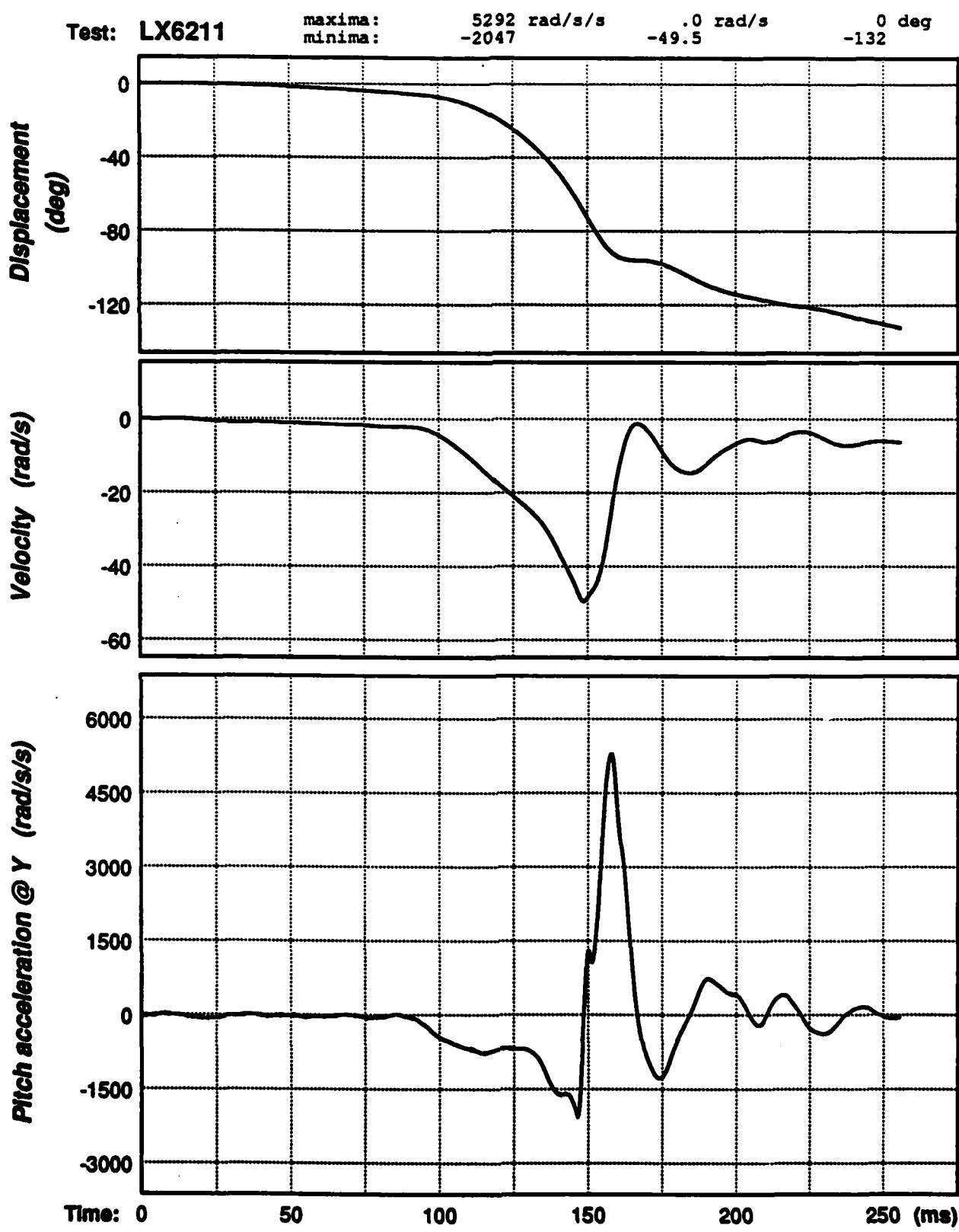


Figure B-37. Head pitch angular acceleration, velocity, and displacement signals for test LX6211.

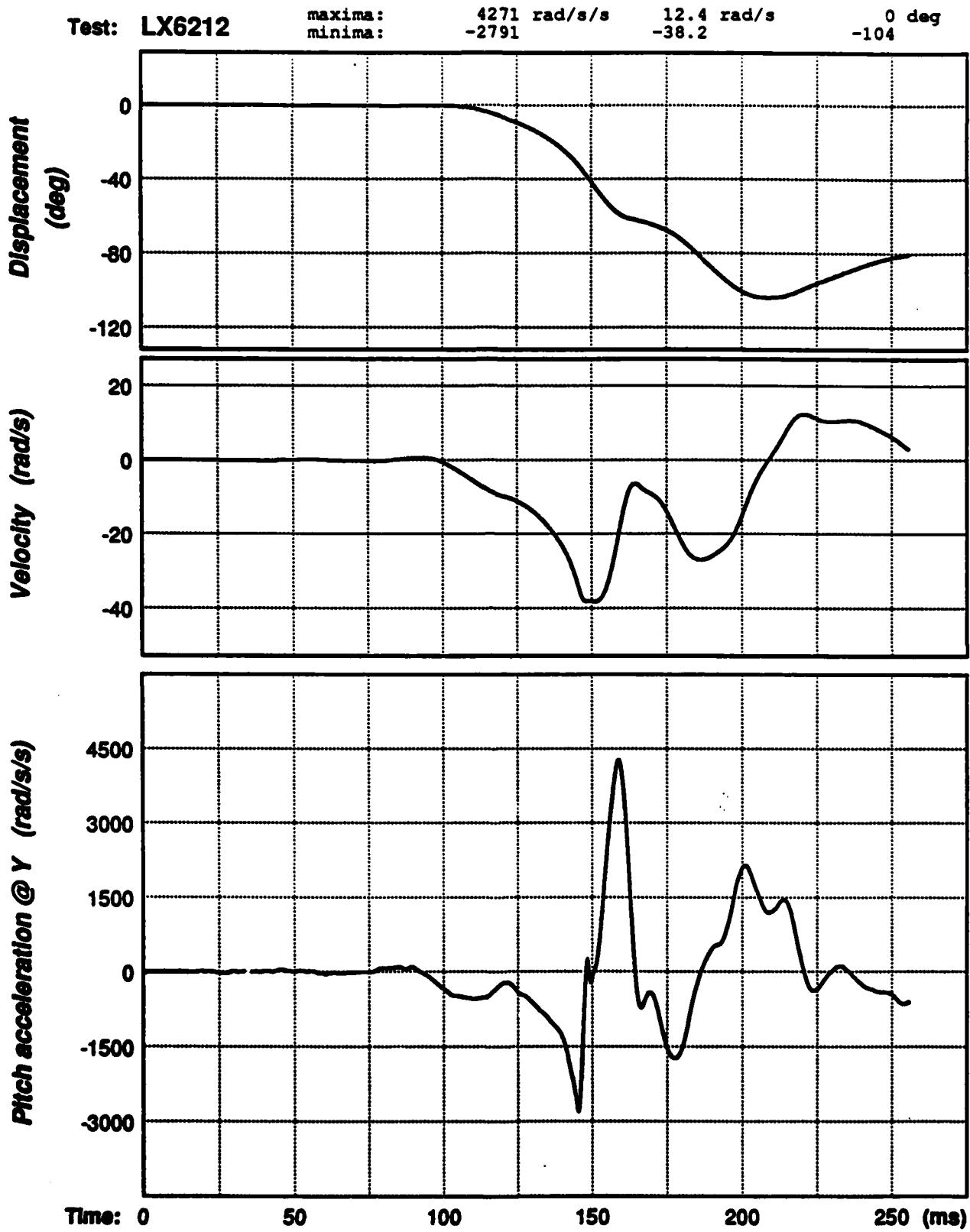


Figure B-38. Head pitch angular acceleration, velocity, and displacement signals for test LX6212.

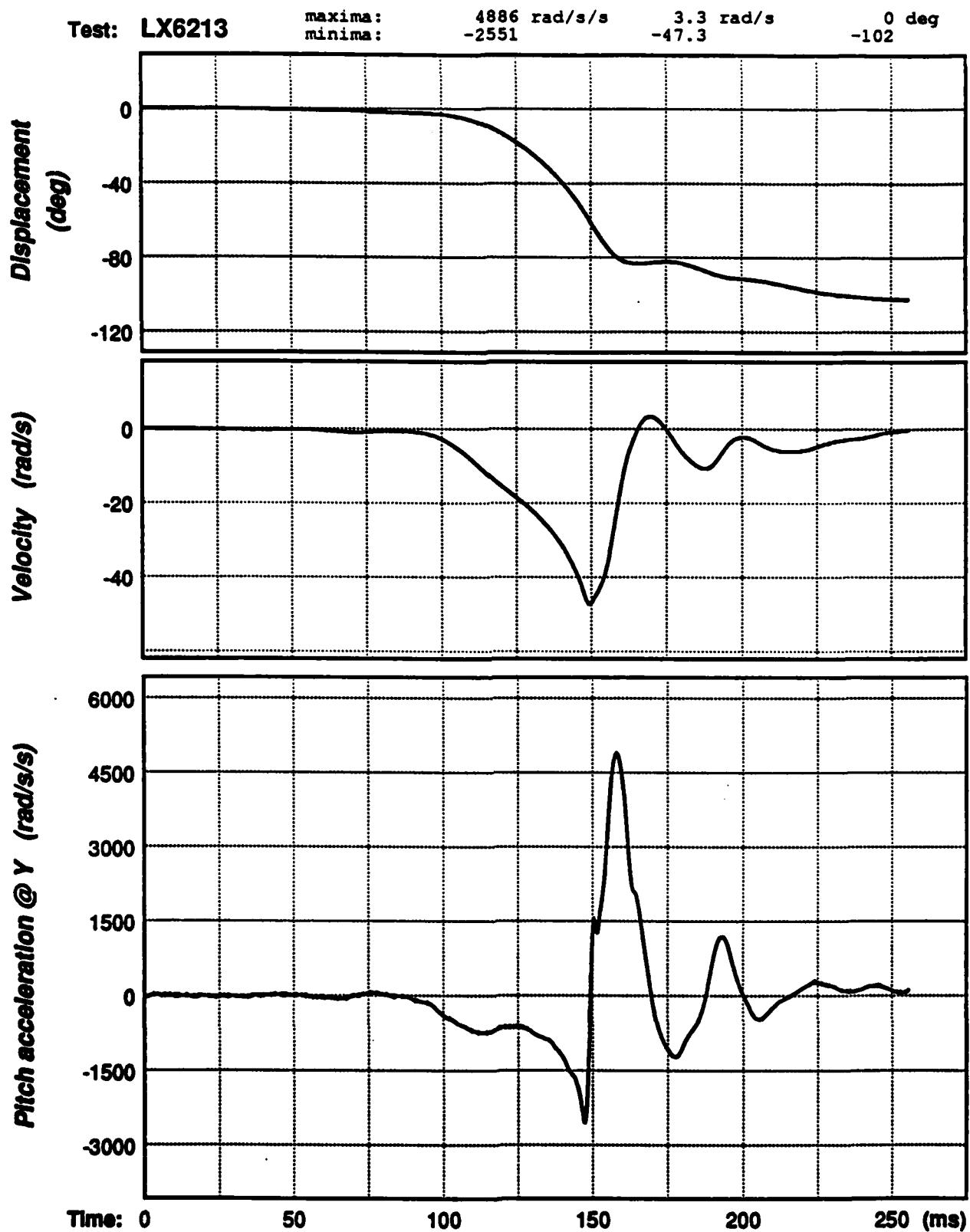


Figure B-39. Head pitch angular acceleration, velocity, and displacement signals for test LX6213.

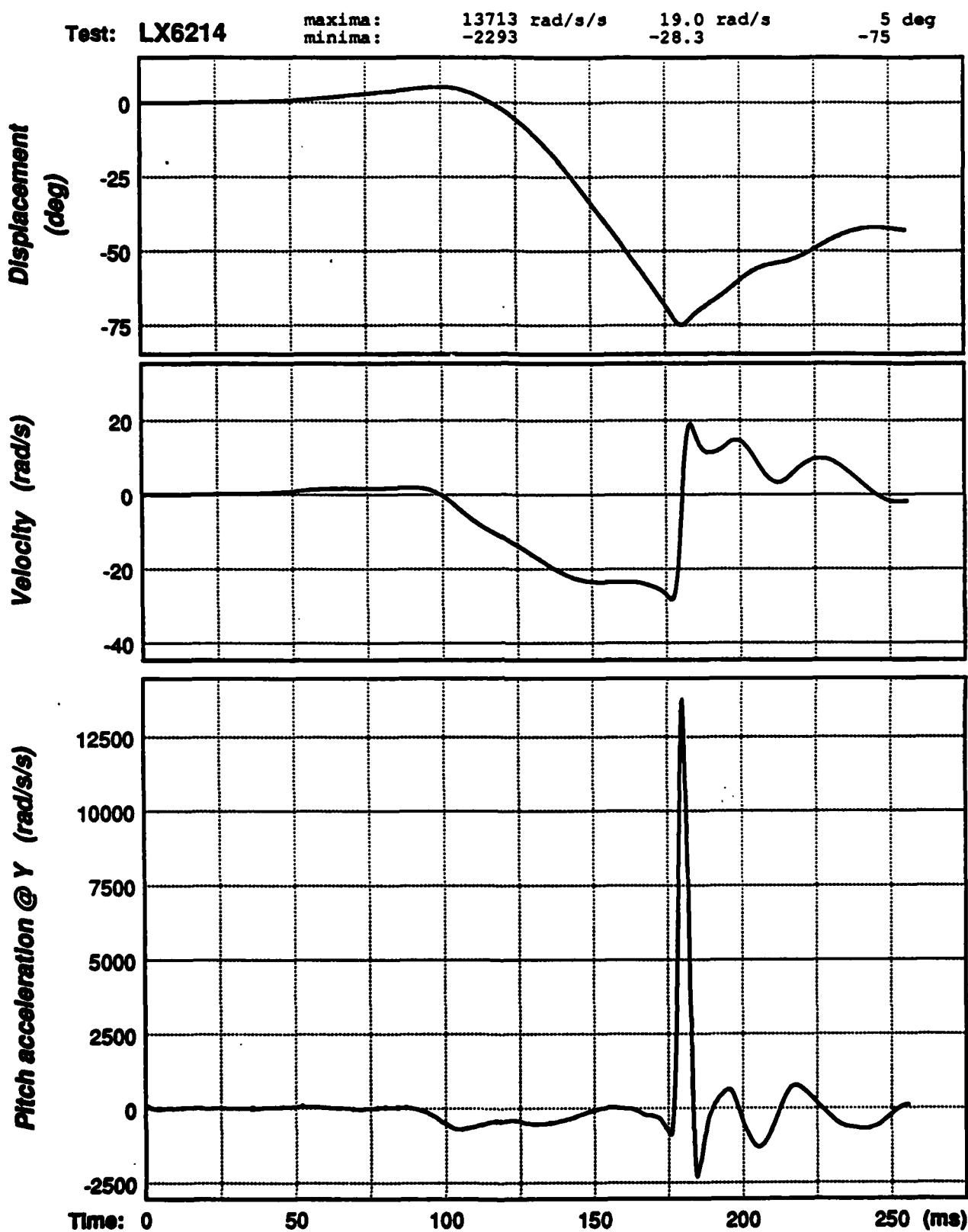


Figure B-40. Head pitch angular acceleration, velocity, and displacement signals for test LX6214.

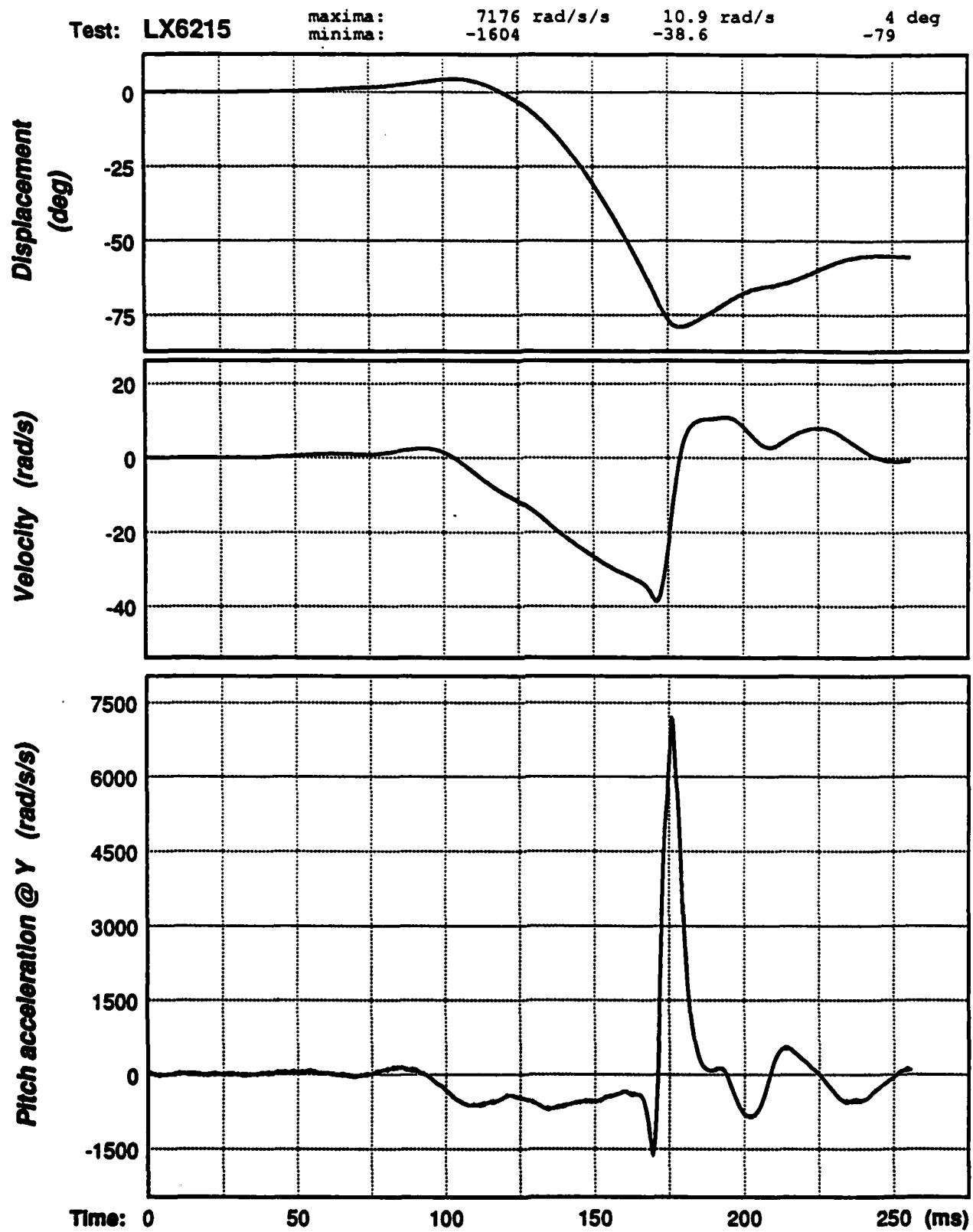


Figure B-41. Head pitch angular acceleration, velocity, and displacement signals for test LX6215.

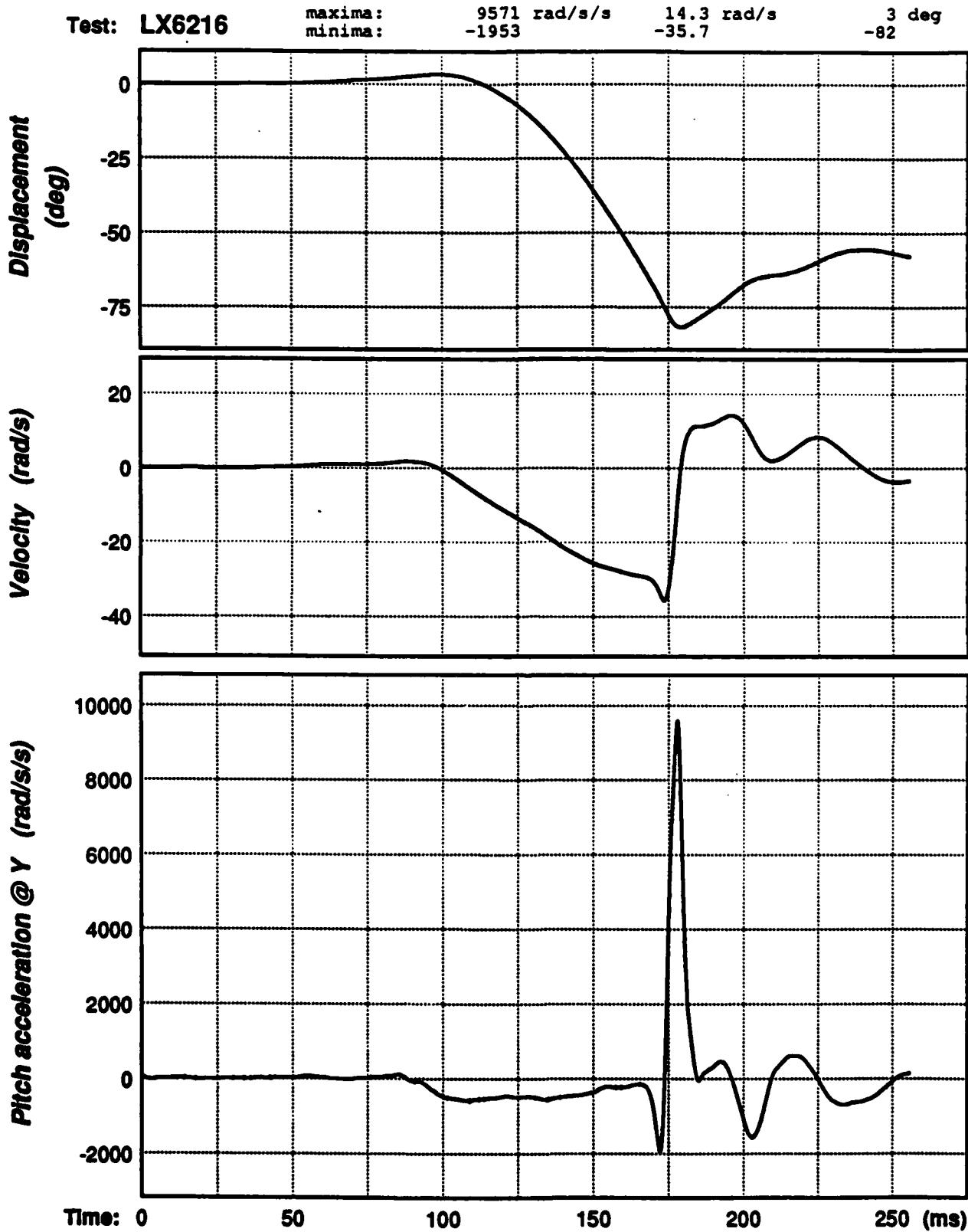


Figure B-42. Head pitch angular acceleration, velocity, and displacement signals for test LX6216.

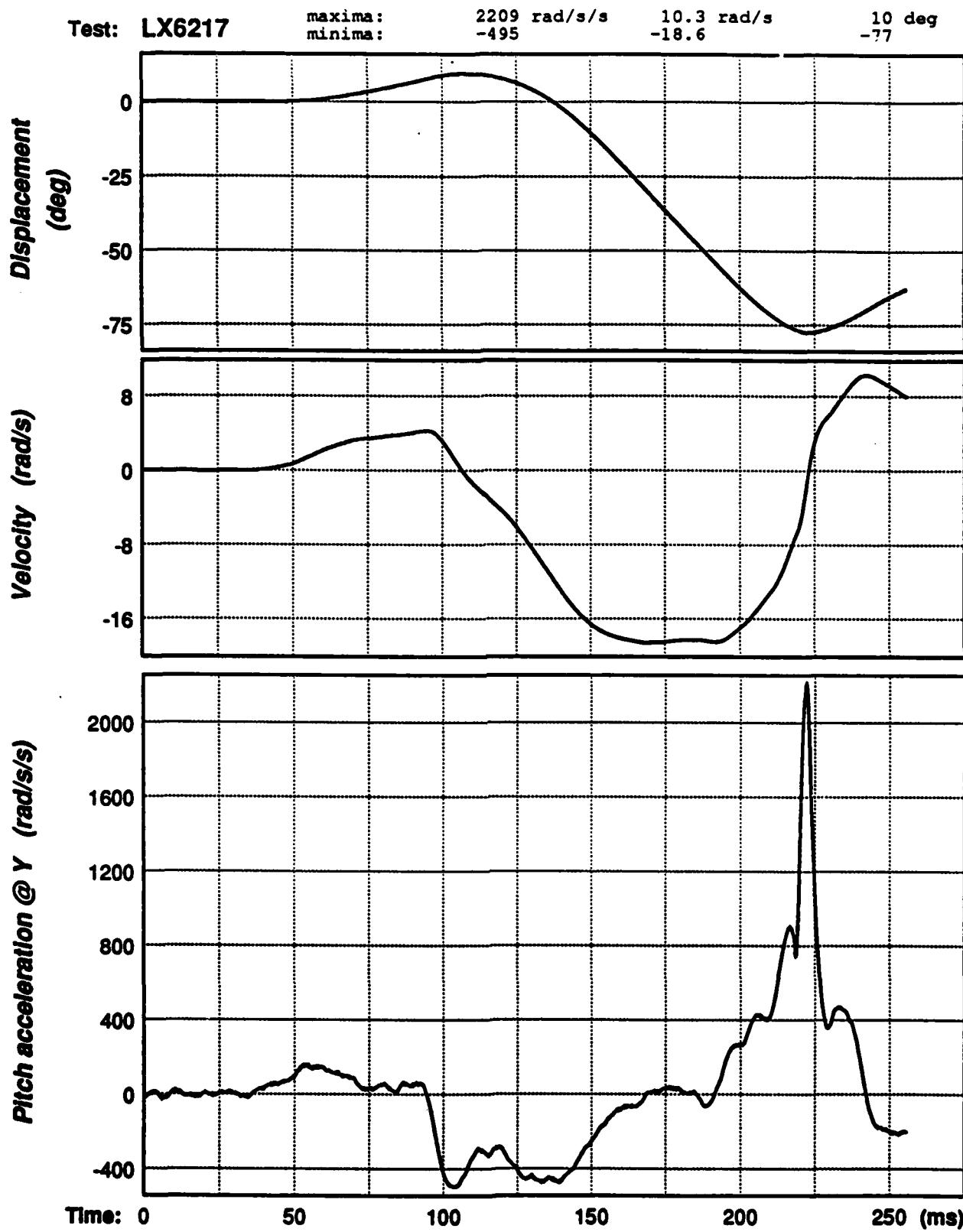


Figure B-43. Head pitch angular acceleration, velocity, and displacement signals for test LX6217.

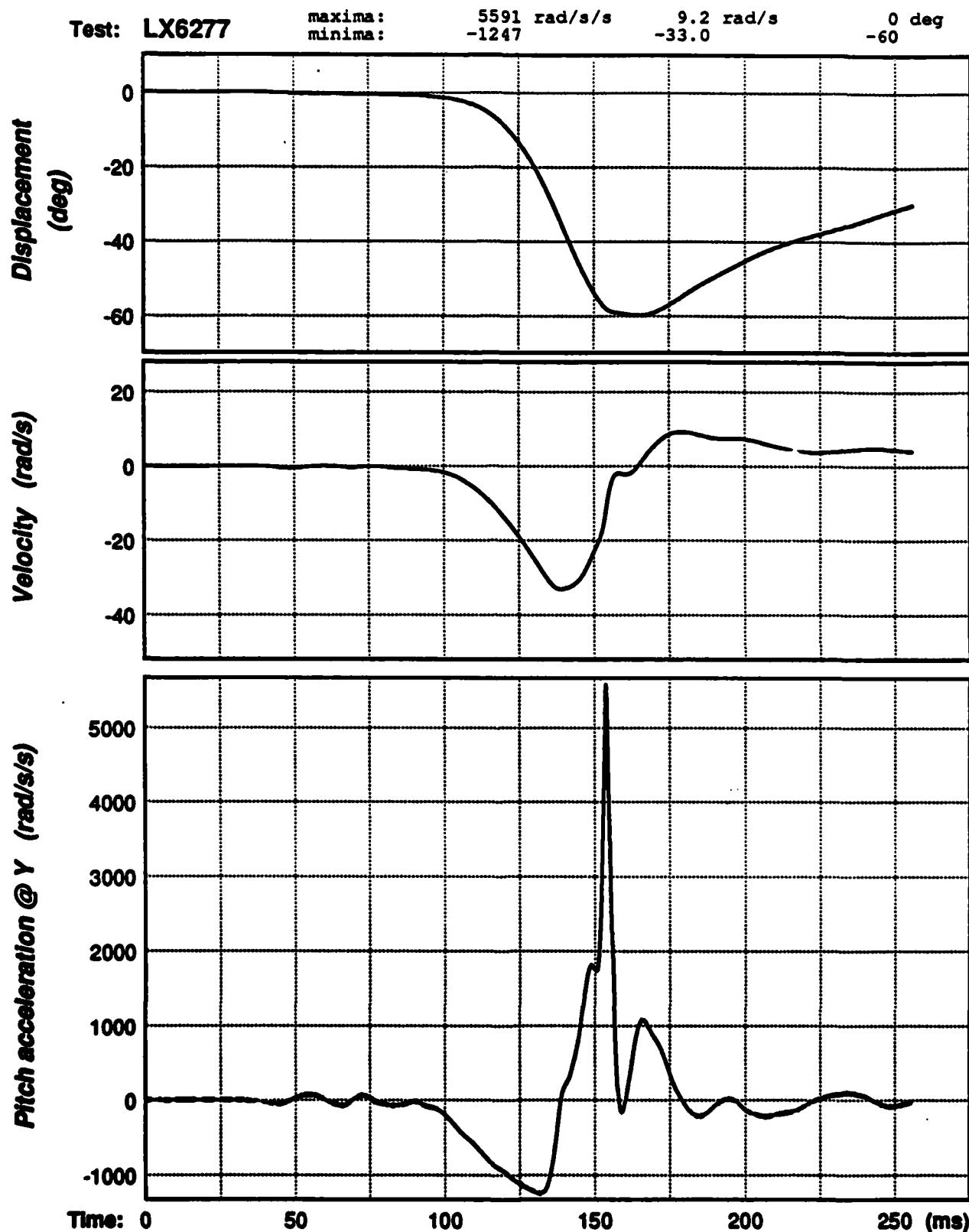


Figure B-44. Head pitch angular acceleration, velocity, and displacement signals for test LX6277.

Appendix C

This appendix contains processed transducer signals from 11 tests where an airbag was mounted below the gunsight to supplement the standard restraint system in the Cobra and Apache.

These include five Cobra tests (LX6269 thru LX6273) and six Apache tests (LX6278 thru LX6283) which were all conducted in the second phase of testing.

Figures C-1 thru C-11 show the sled acceleration pulses and computed velocity and jerk signals for the 11 tests. Note for test LX6269, the sled pulse was the only transducer signal that was available for processing.

Figures C-12 thru C-21 display components and resultant head linear accelerations.

Figures C-22 thru C-31 display the head roll acceleration signals and computed angular velocities and displacements.

Figures C-32 thru C-41 show the head pitch acceleration signals and computed angular velocities and displacements.

Figures B-42 thru A-51 display the amounts of belt extension and the computed velocities and accelerations.

Appendix C

- 1. LX6269**
- 2. LX6270**
- 3. LX6271**
- 4. LX6272**
- 5. LX6273**
- 6. LX6278**
- 7. LX6279**
- 8. LX6280**
- 9. LX6281**
- 10. LX6282**
- 11. LX6283**

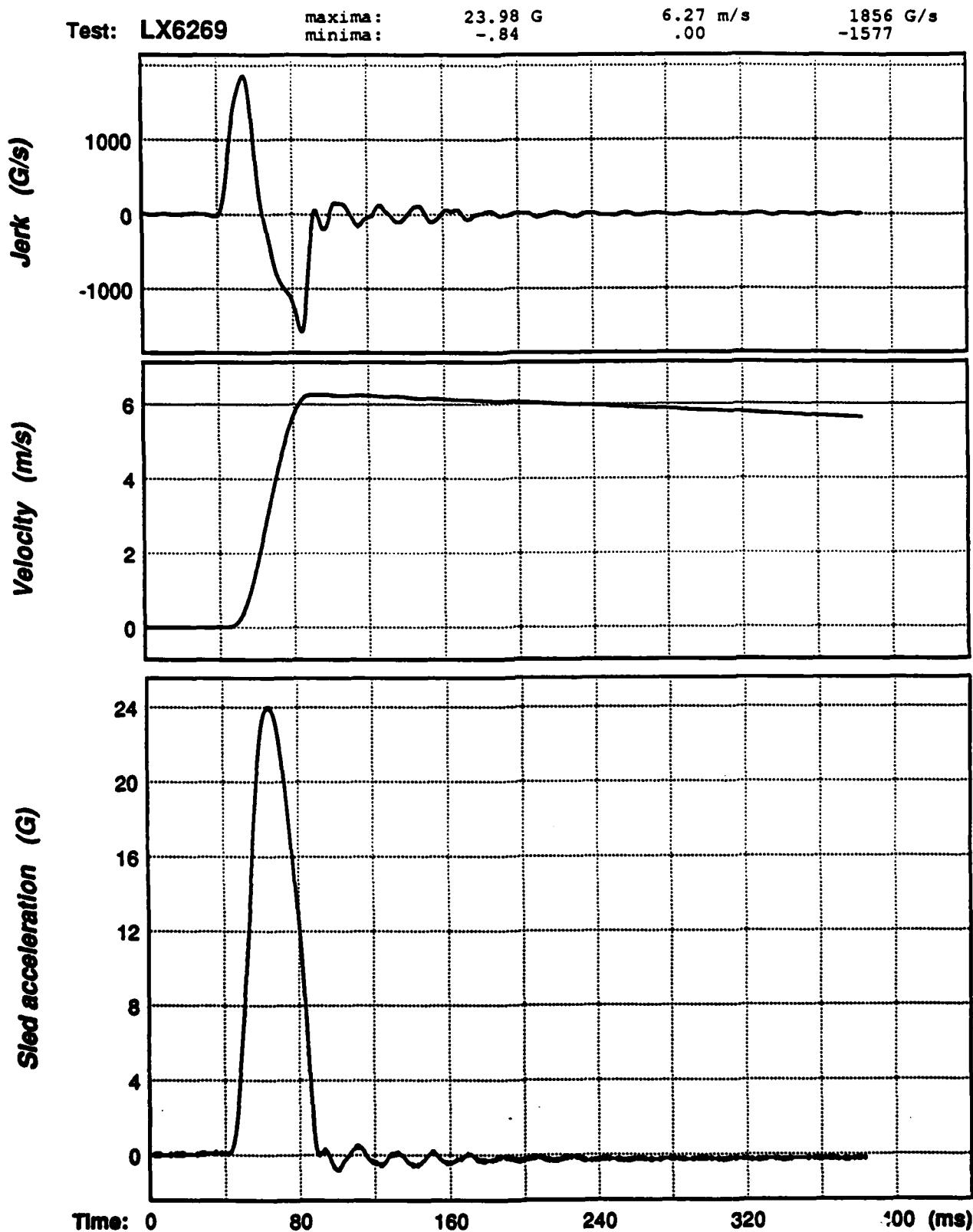


Figure C-1. Sled acceleration signal and its computed velocity and jerk for test LX6269.

Test: LX6270 maxima: 20.26 G
minima: -.76 10.79 m/s
.00 774 G/s
-724

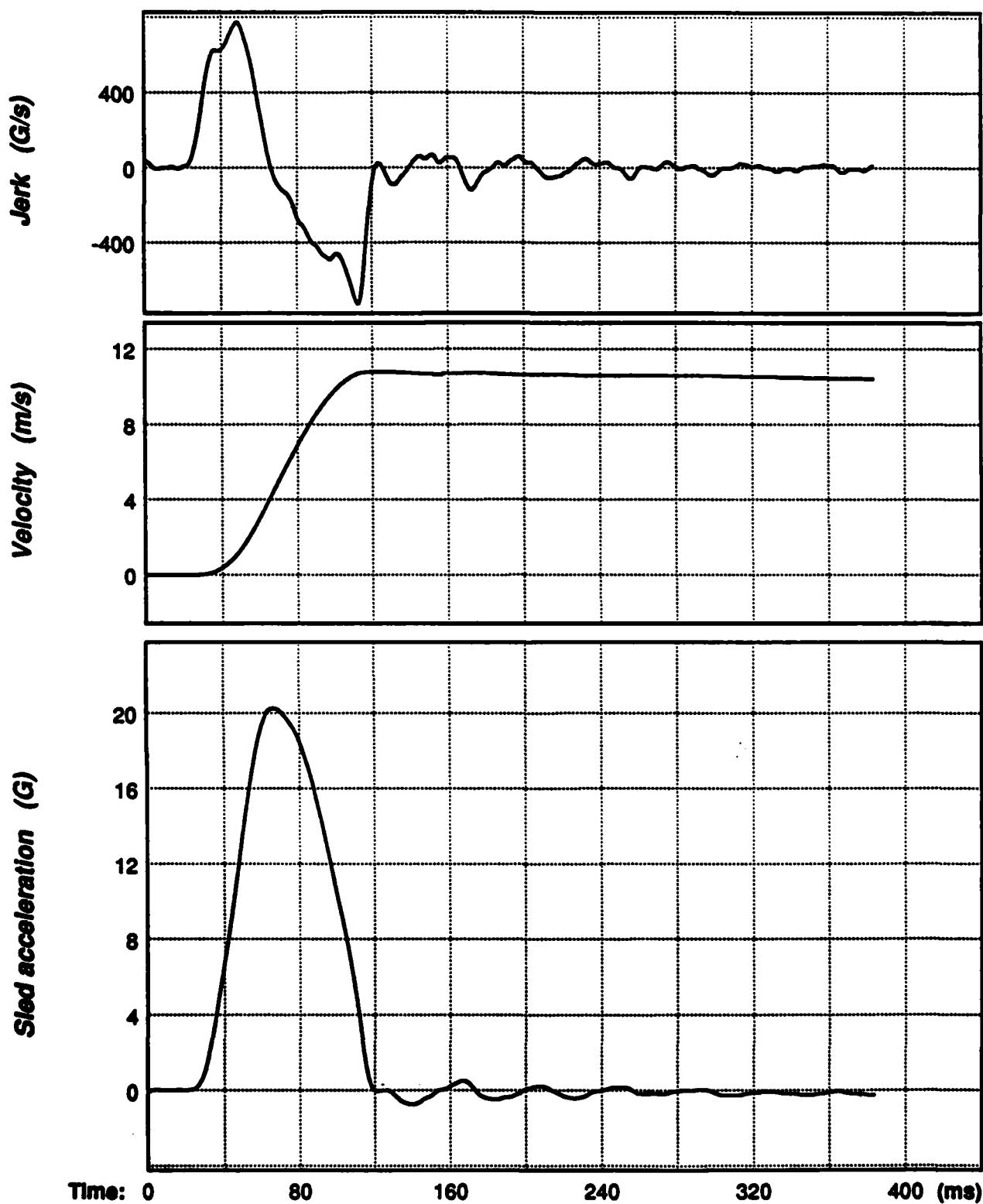


Figure C-2. Sled acceleration signal and its computed velocity and jerk for test LX6270.

Test: LX6271

maxima:
minima:

23.15 G
-.71

11.50 m/s
.00

928 G/s
-931

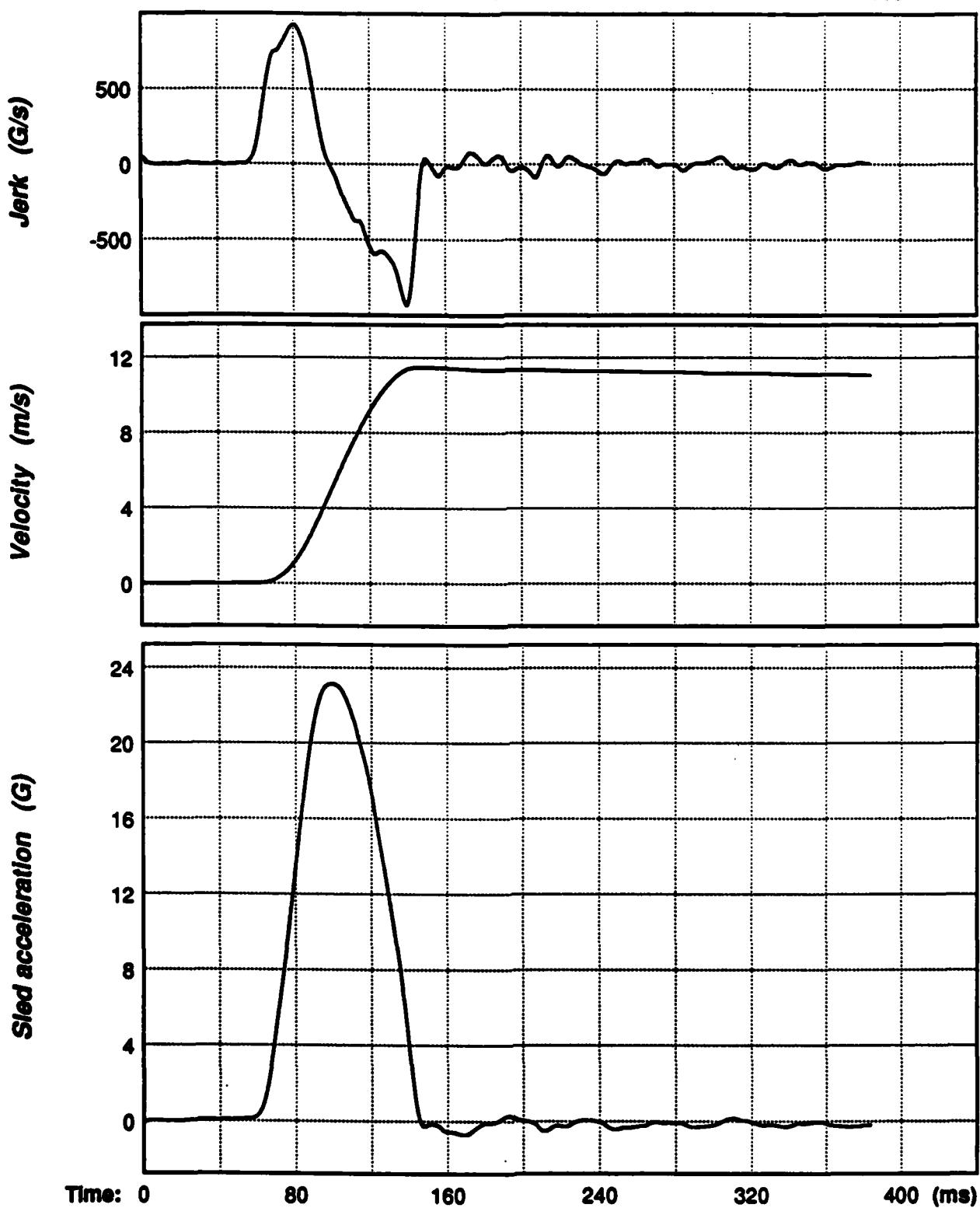


Figure C-3. Sled acceleration signal and its computed velocity and jerk for test LX6271.

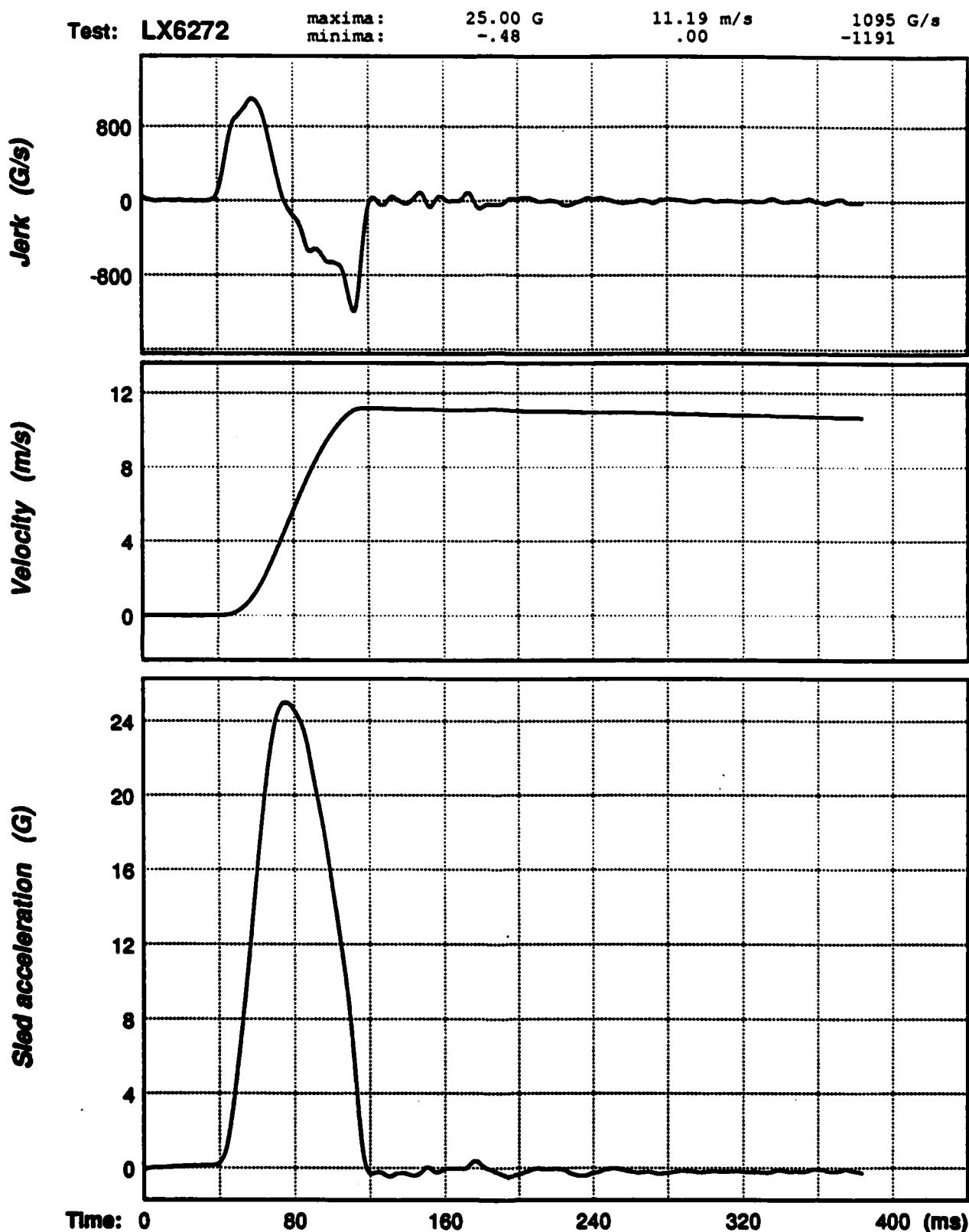


Figure C-4. Sled acceleration signal and its computed velocity and jerk for test LX6272.

Test: LX6273 maxima: 24.70 G 11.09 m/s 1078 G/s
minima: -.48 .00 -1145

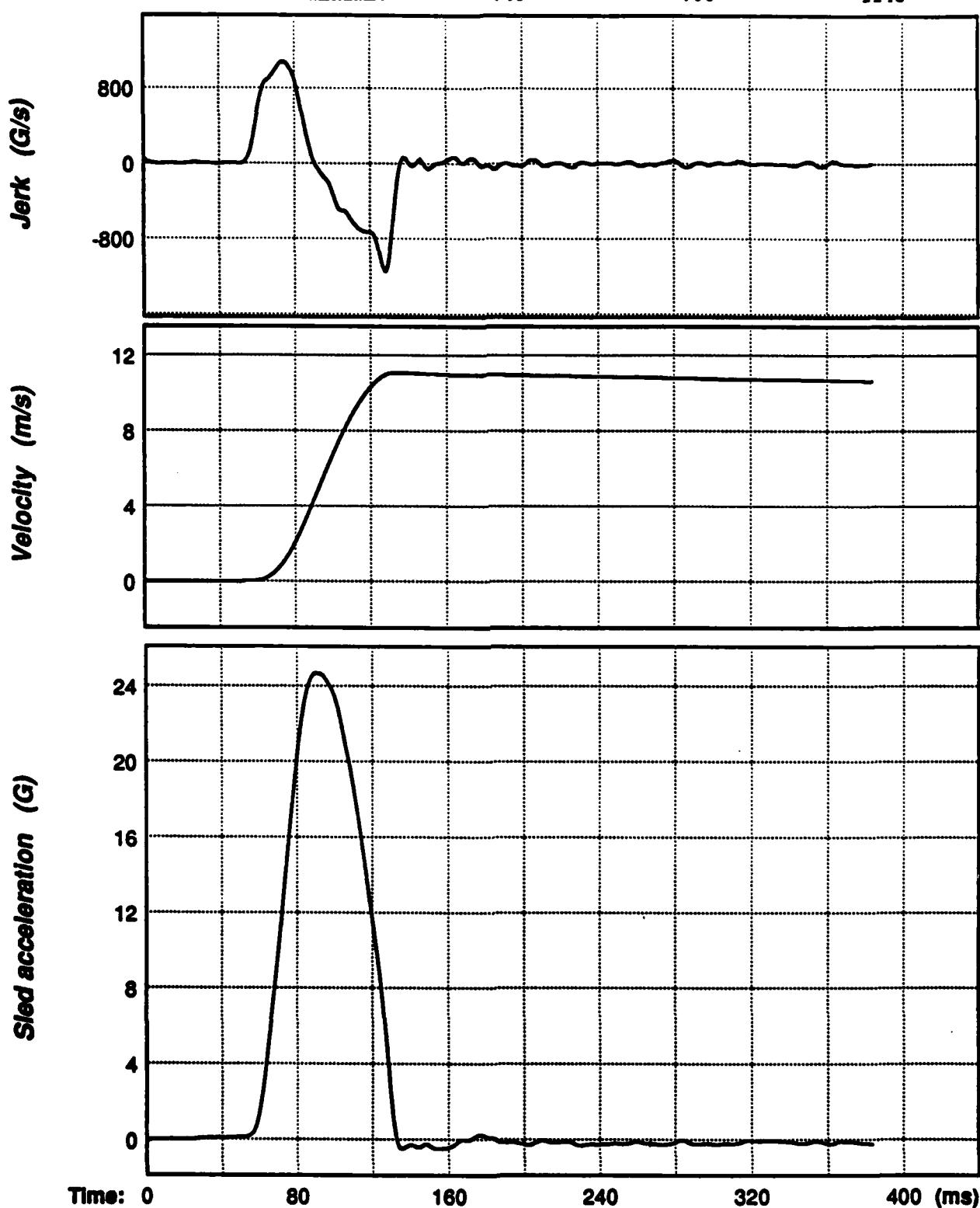


Figure C-5. Sled acceleration signal and its computed velocity and jerk for test LX6273.

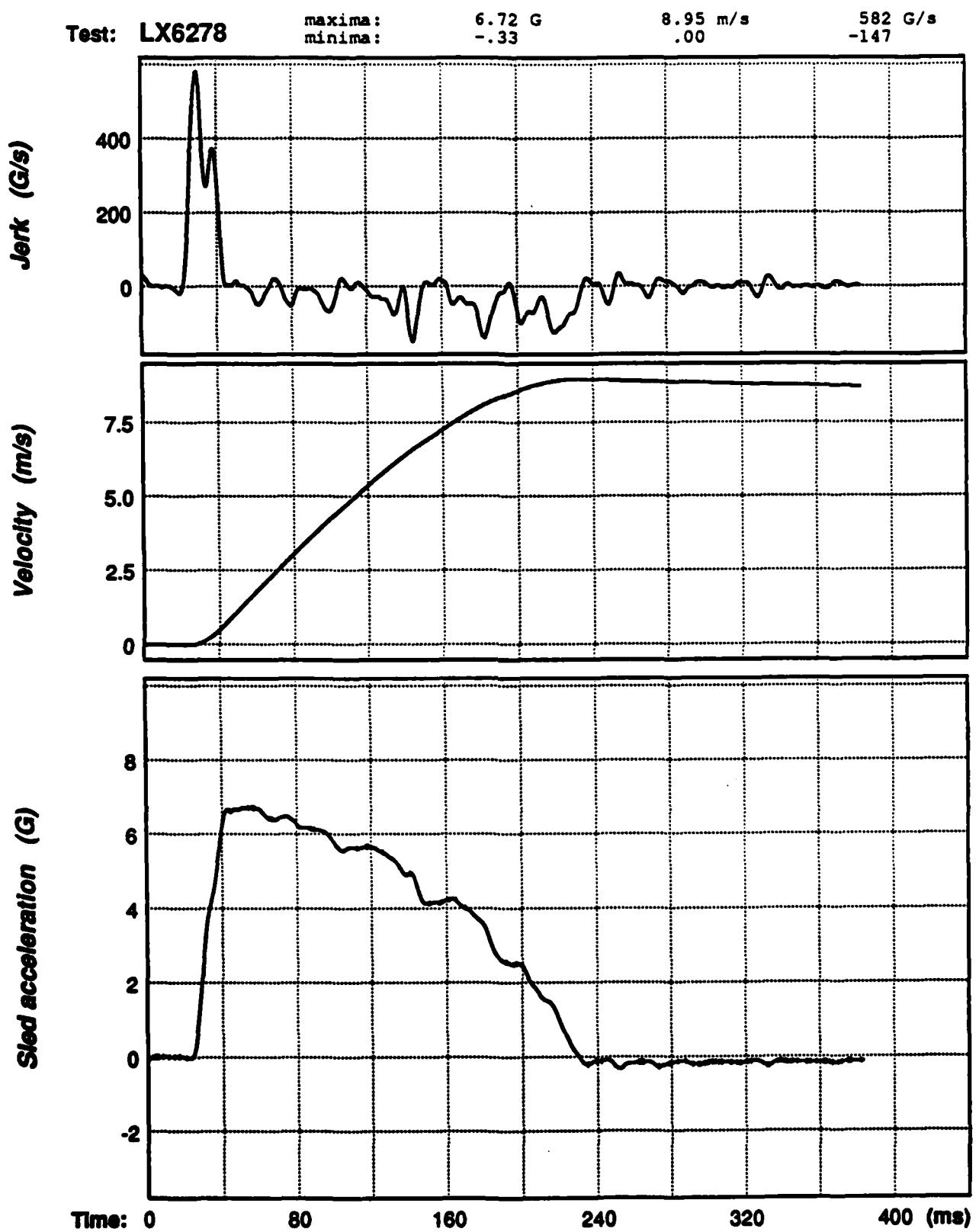


Figure C-6. Sled acceleration signal and its computed velocity and jerk for test LX6278.

Test: LX6279 maxima: 7.13 G 9.33 m/s 601 G/s
minima: -.42 .00 -205

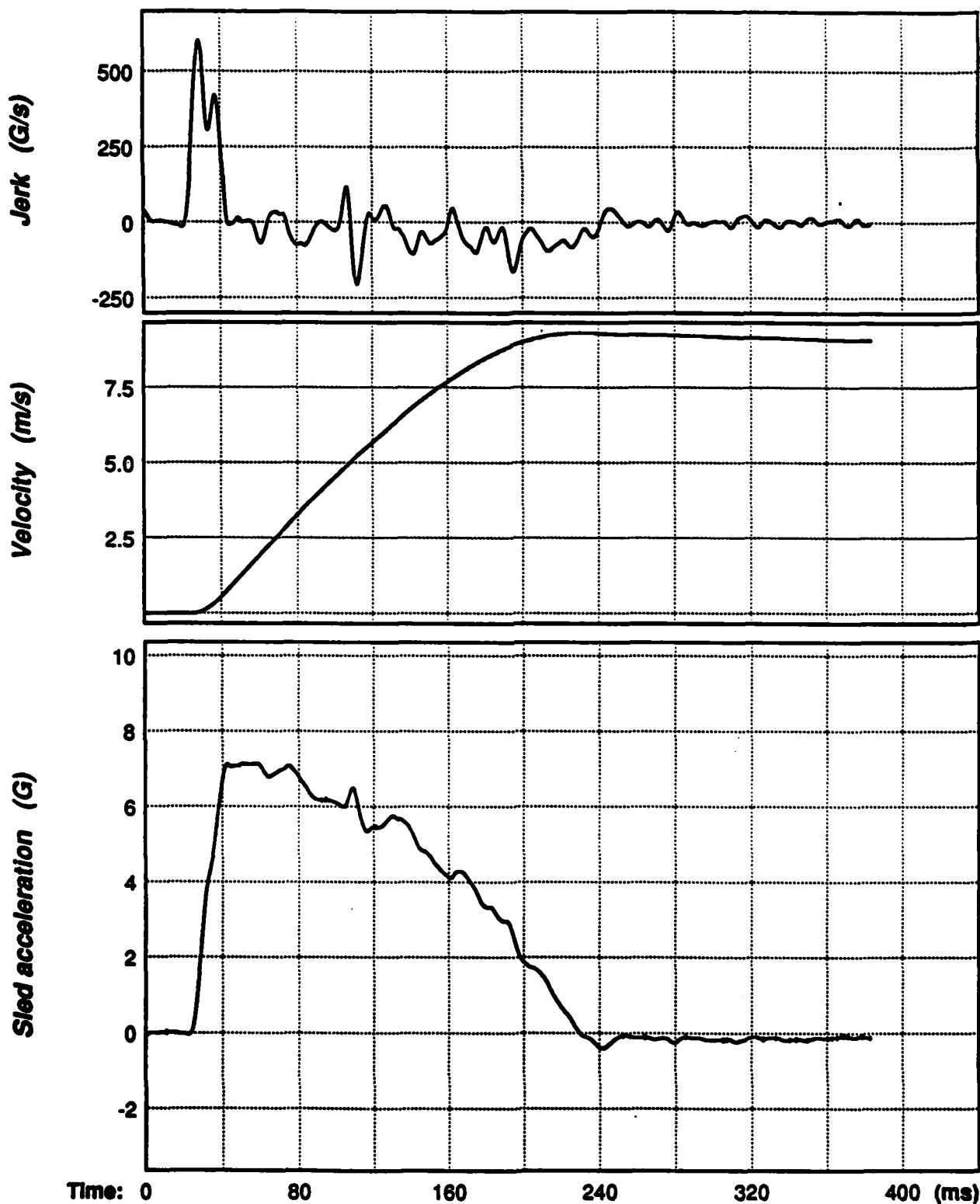


Figure C-7. Sled acceleration signal and its computed velocity and jerk for test LX6279.

Test: LX6280 maxima: 27.81 G 11.74 m/s 1234 G/s
minima: -1.34 .00 -1719

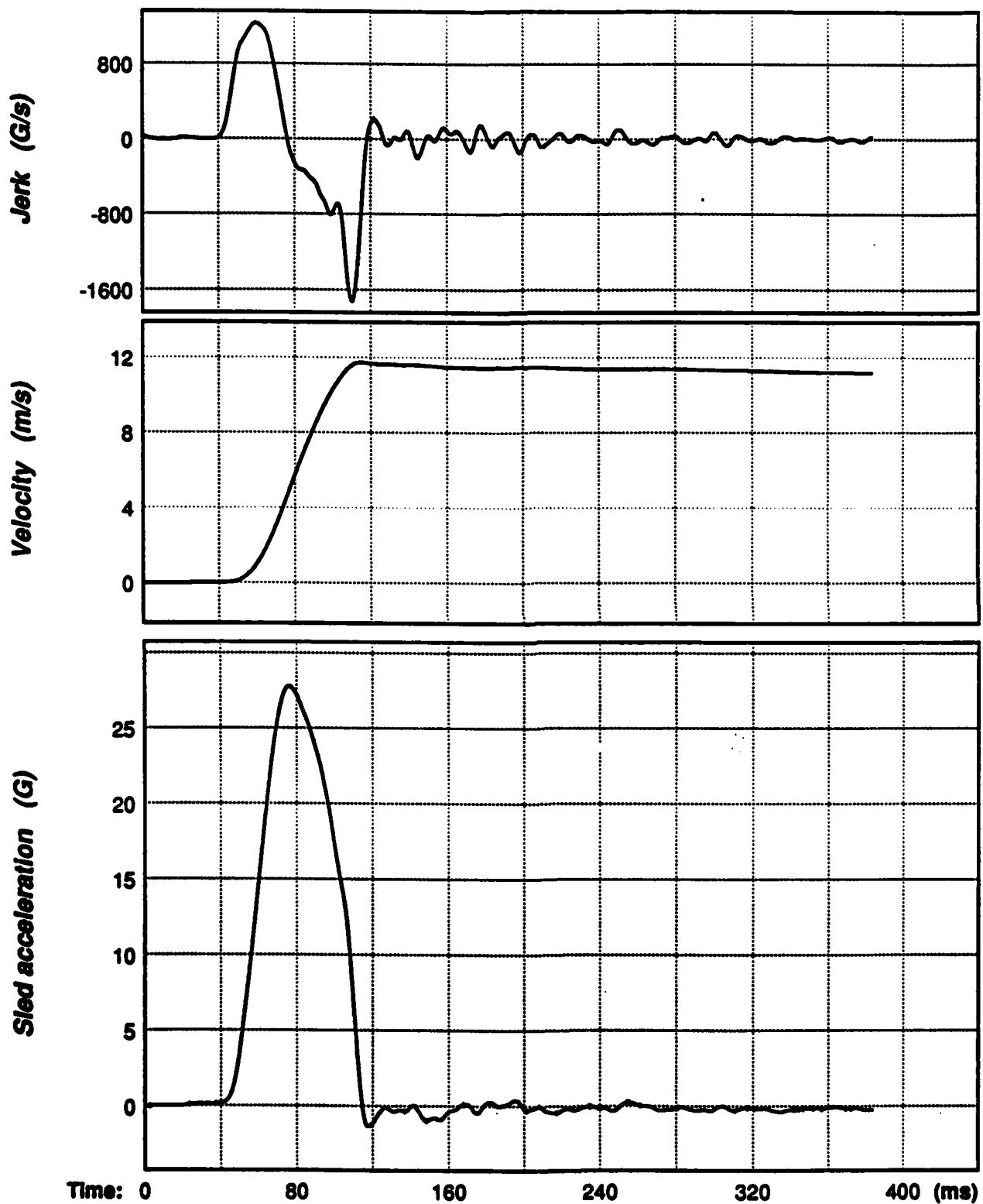


Figure C-8. Sled acceleration signal and its computed velocity and jerk for test LX6280.

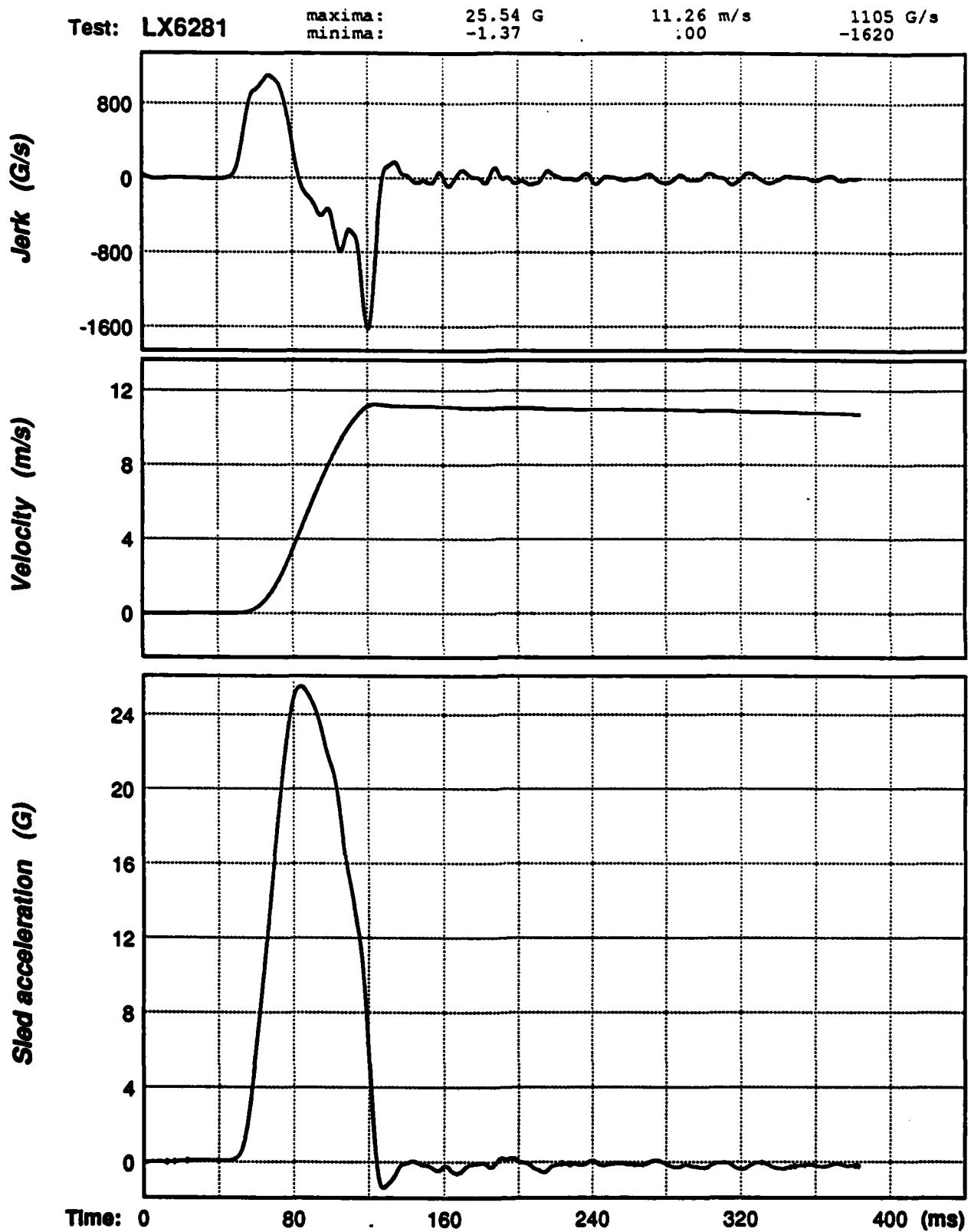


Figure C-9. Sled acceleration signal and its computed velocity and jerk for test LX6281.

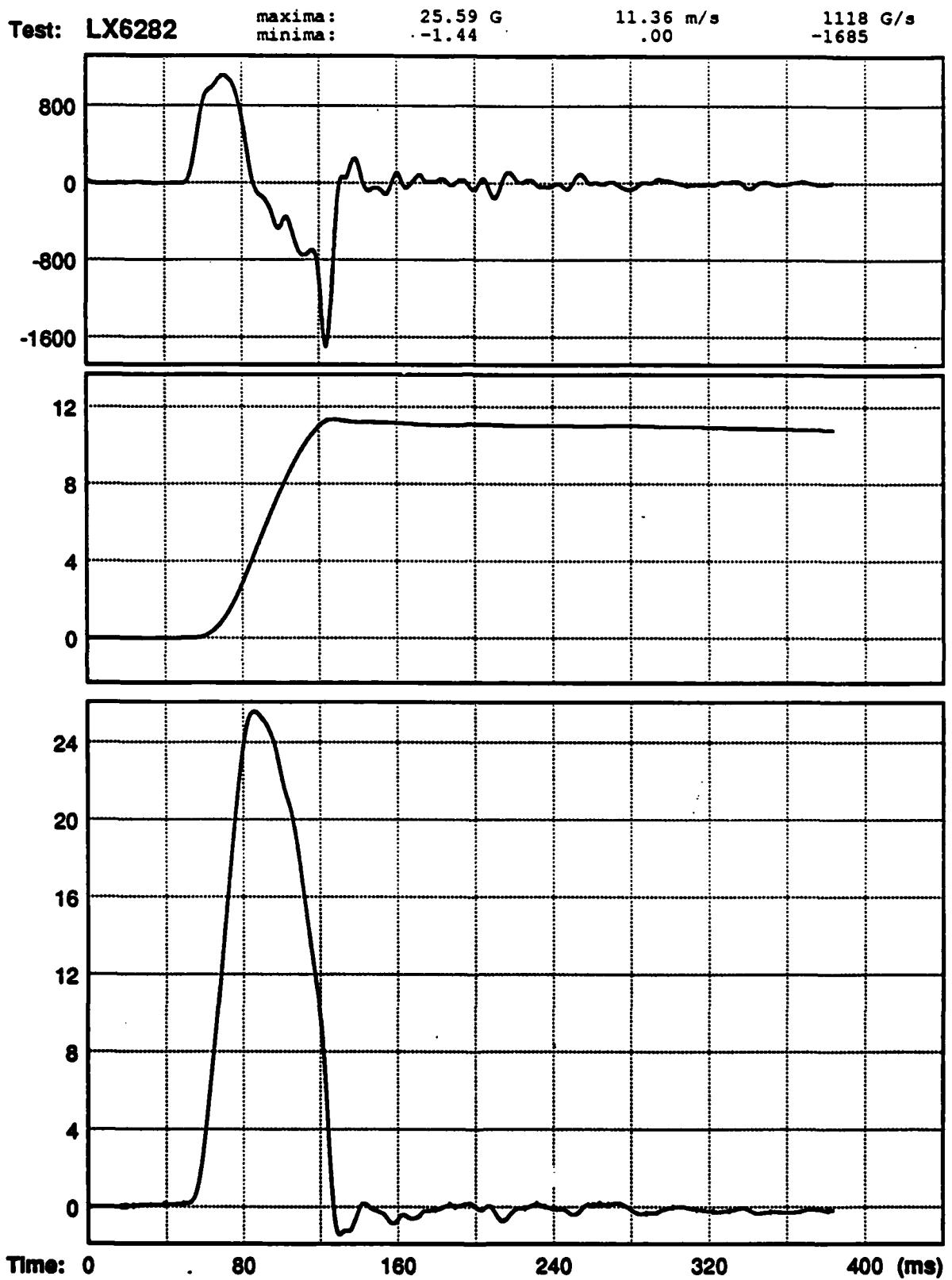


Figure C-10. Sled acceleration signal and its computed velocity and jerk for test LX6282.

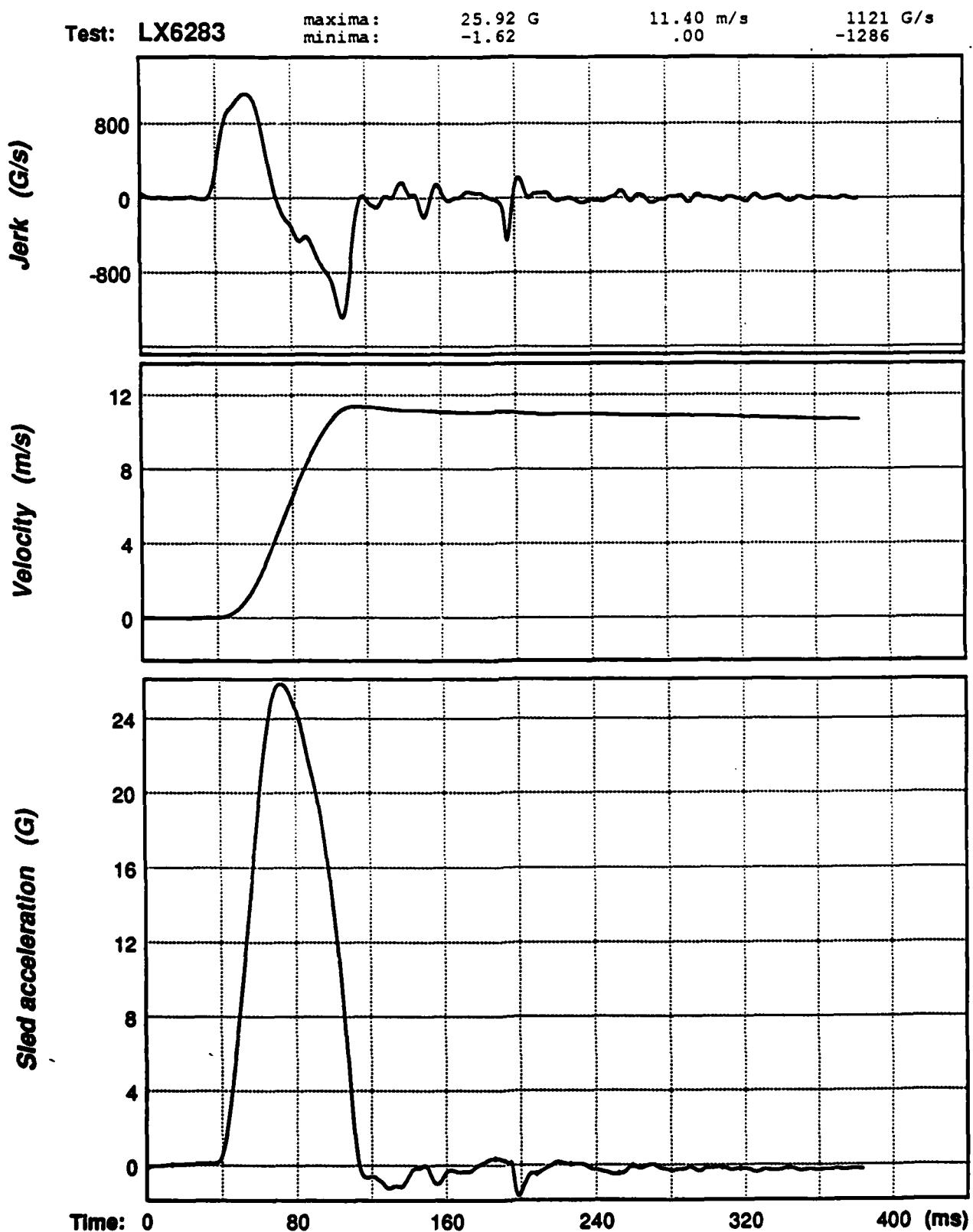


Figure C-11. Sled acceleration signal and its computed velocity and jerk for test LX6283.

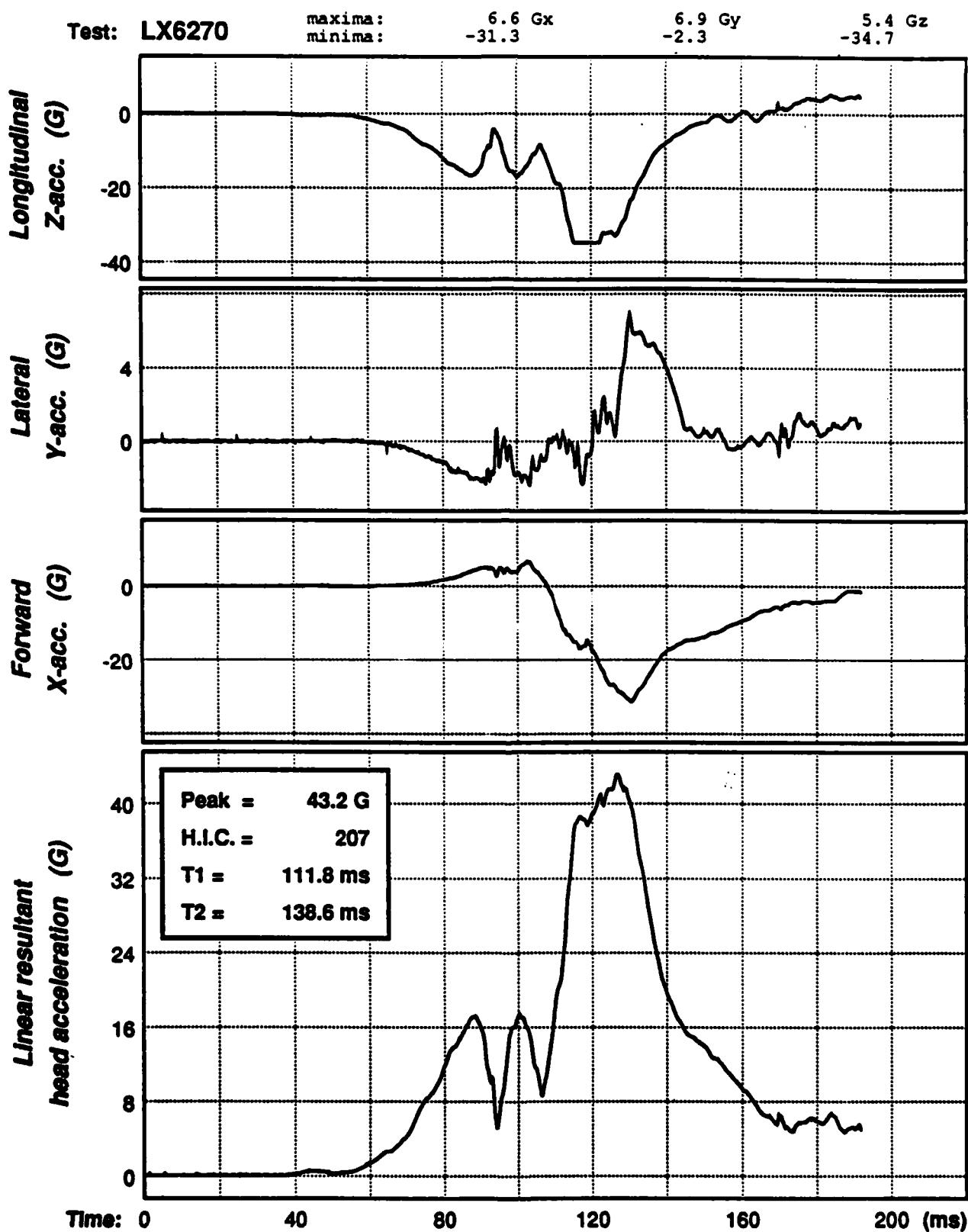


Figure C-12. Three components and resultant of the linear head acceleration for test LX6270.

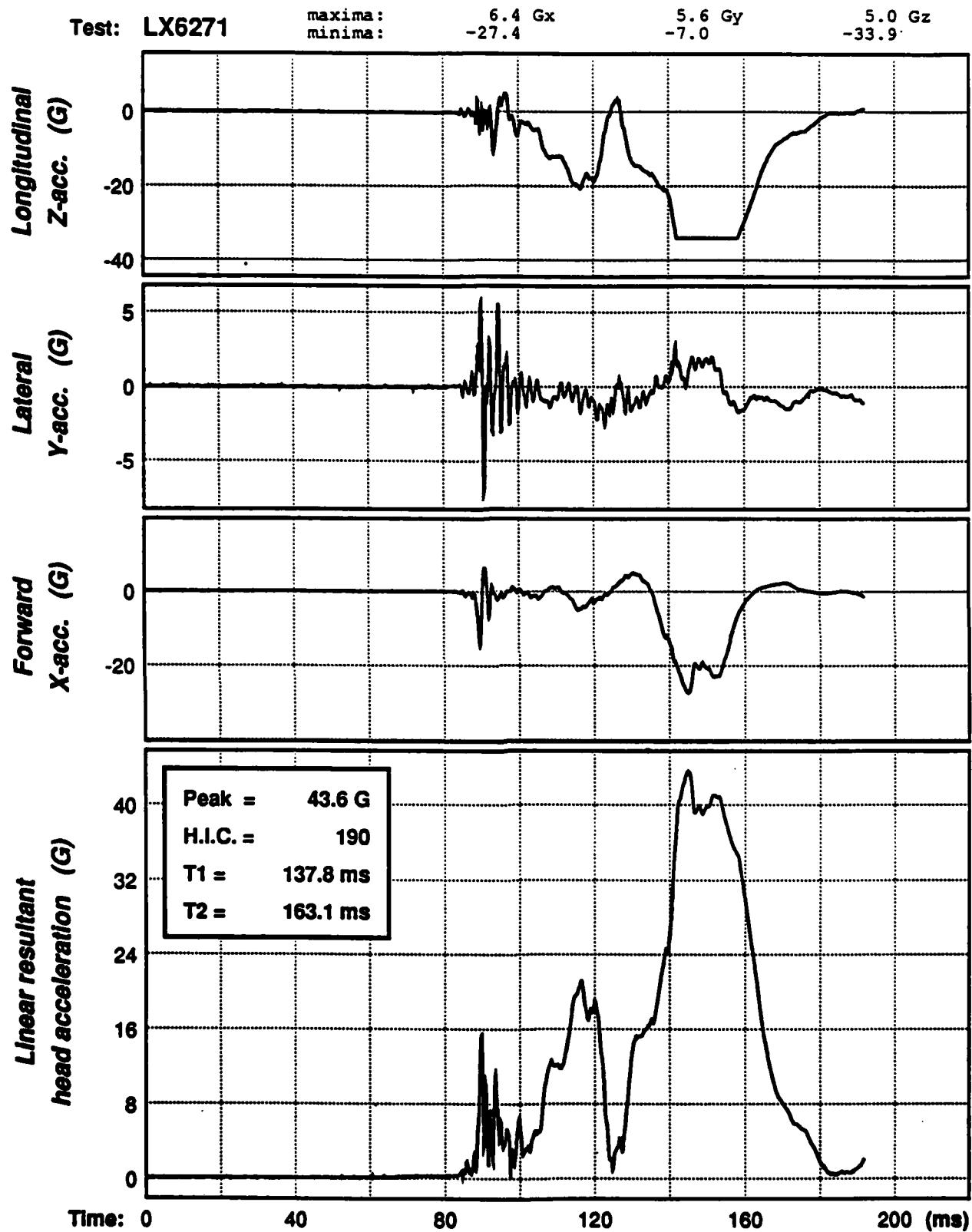


Figure C-13. Three components and resultant of the linear head acceleration for test LX6271.

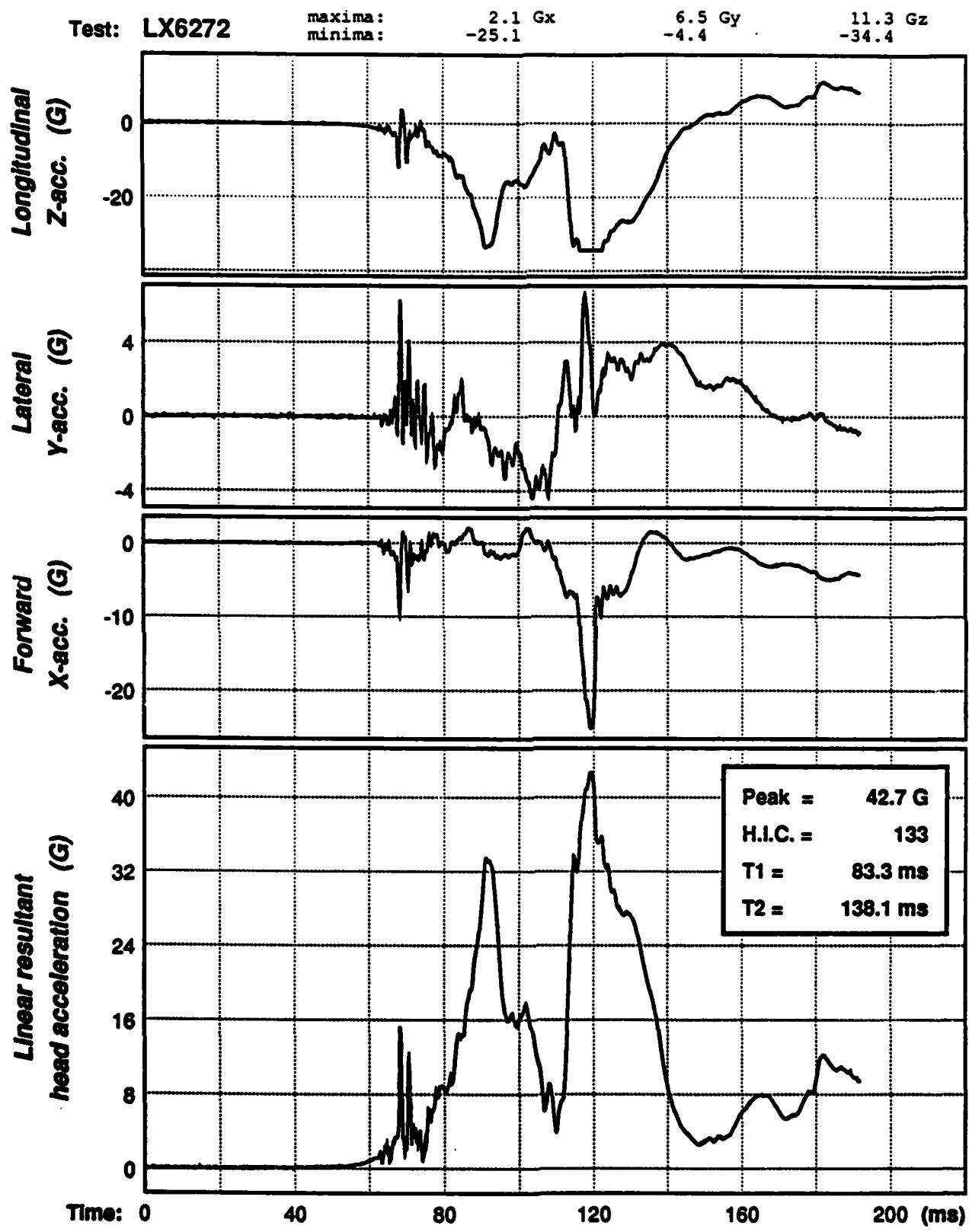


Figure C-14. Three components and resultant of the linear head acceleration for test LX6272.

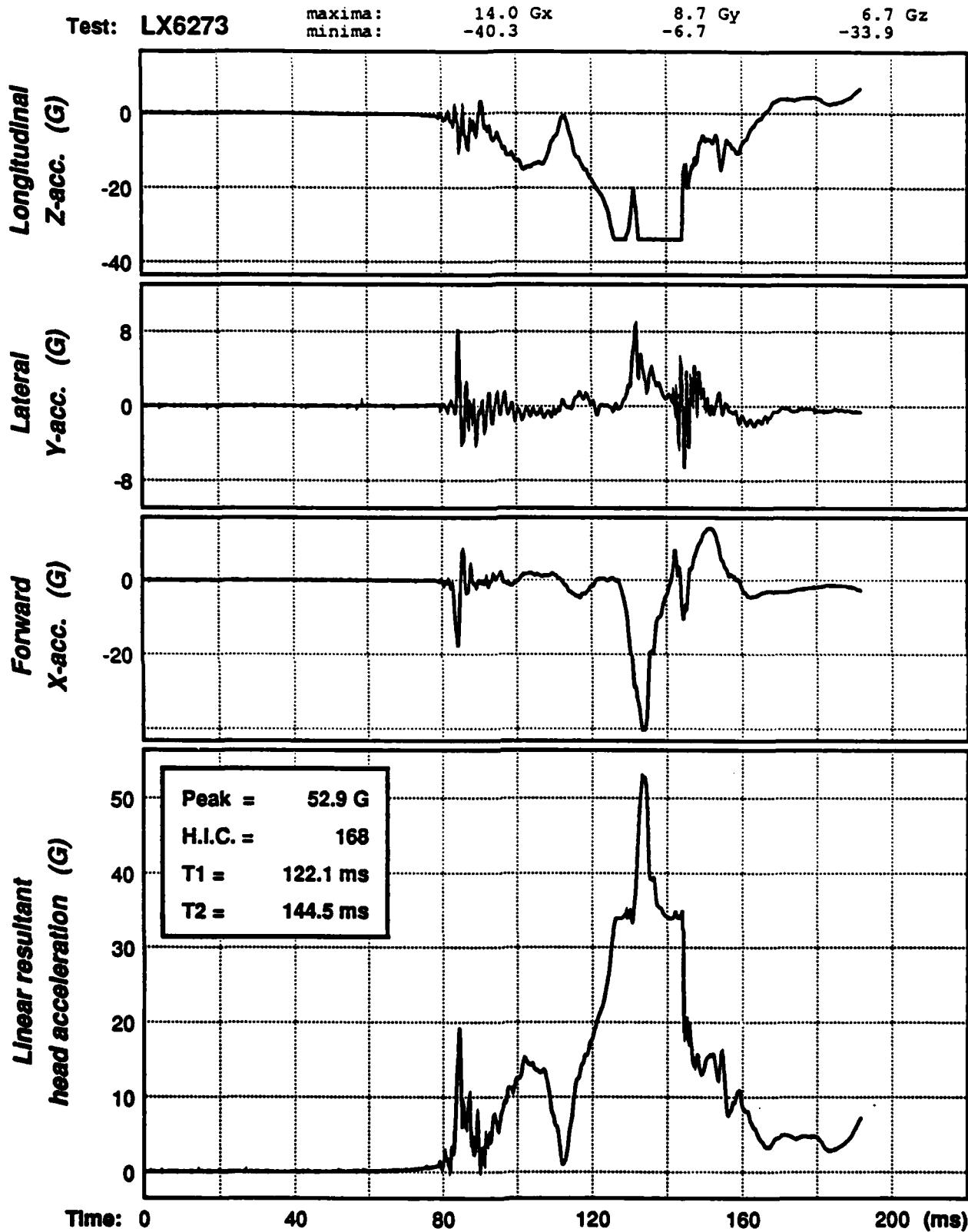


Figure C-15. Three components and resultant of the linear head acceleration for test LX6273.

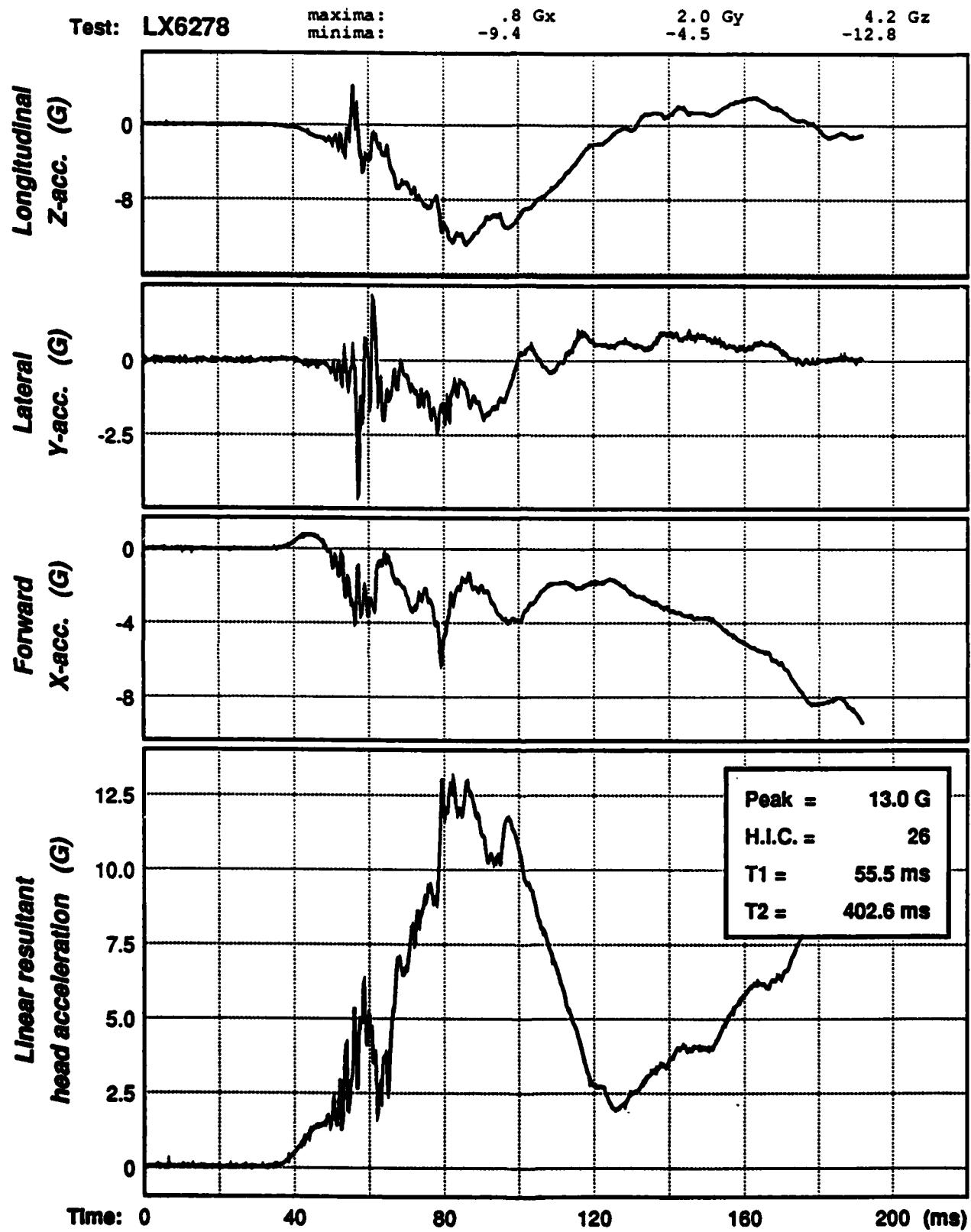


Figure C-16. Three components and resultant of the linear head acceleration for test LX6278.

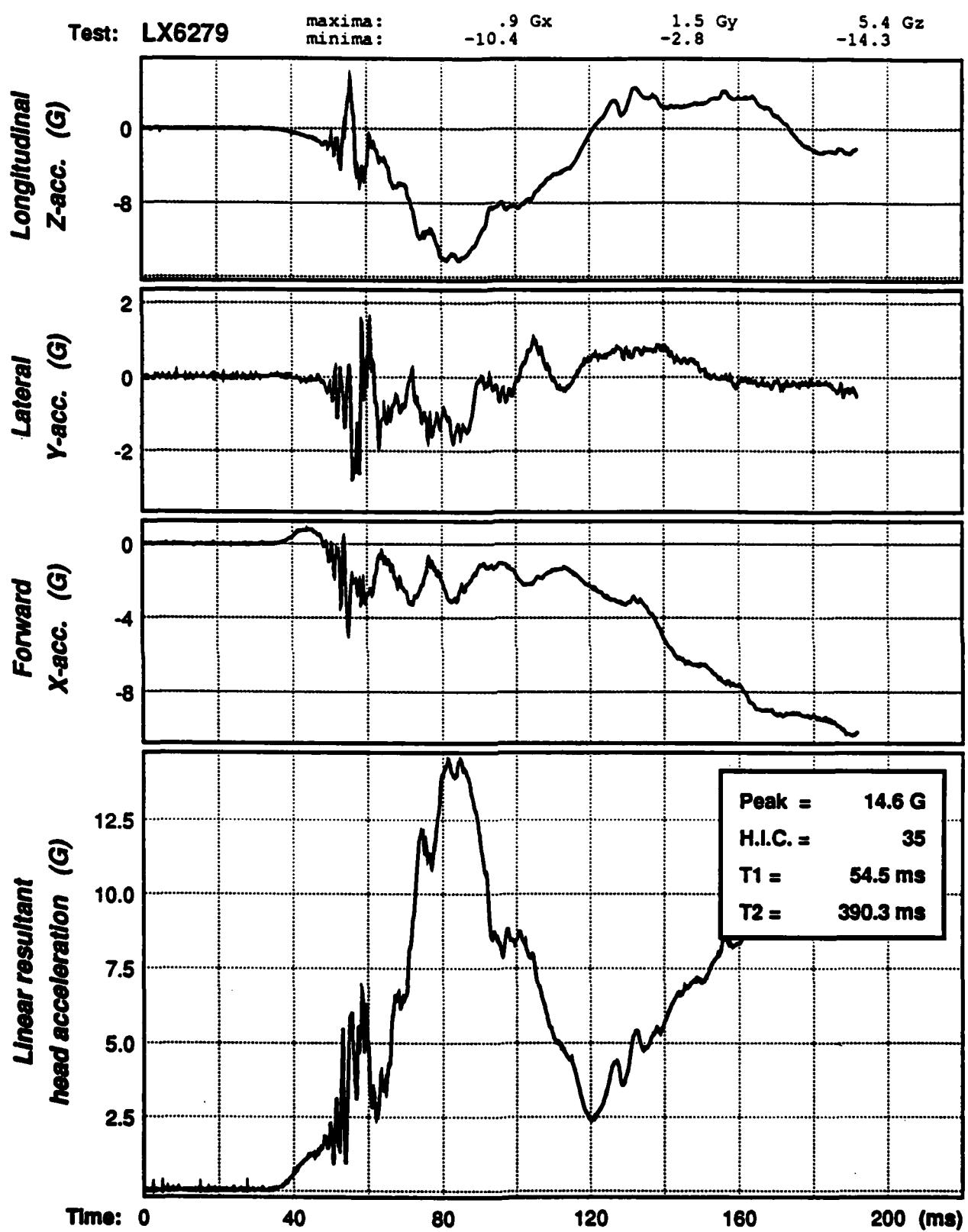


Figure C-17. Three components and resultant of the linear head acceleration for test LX6279.

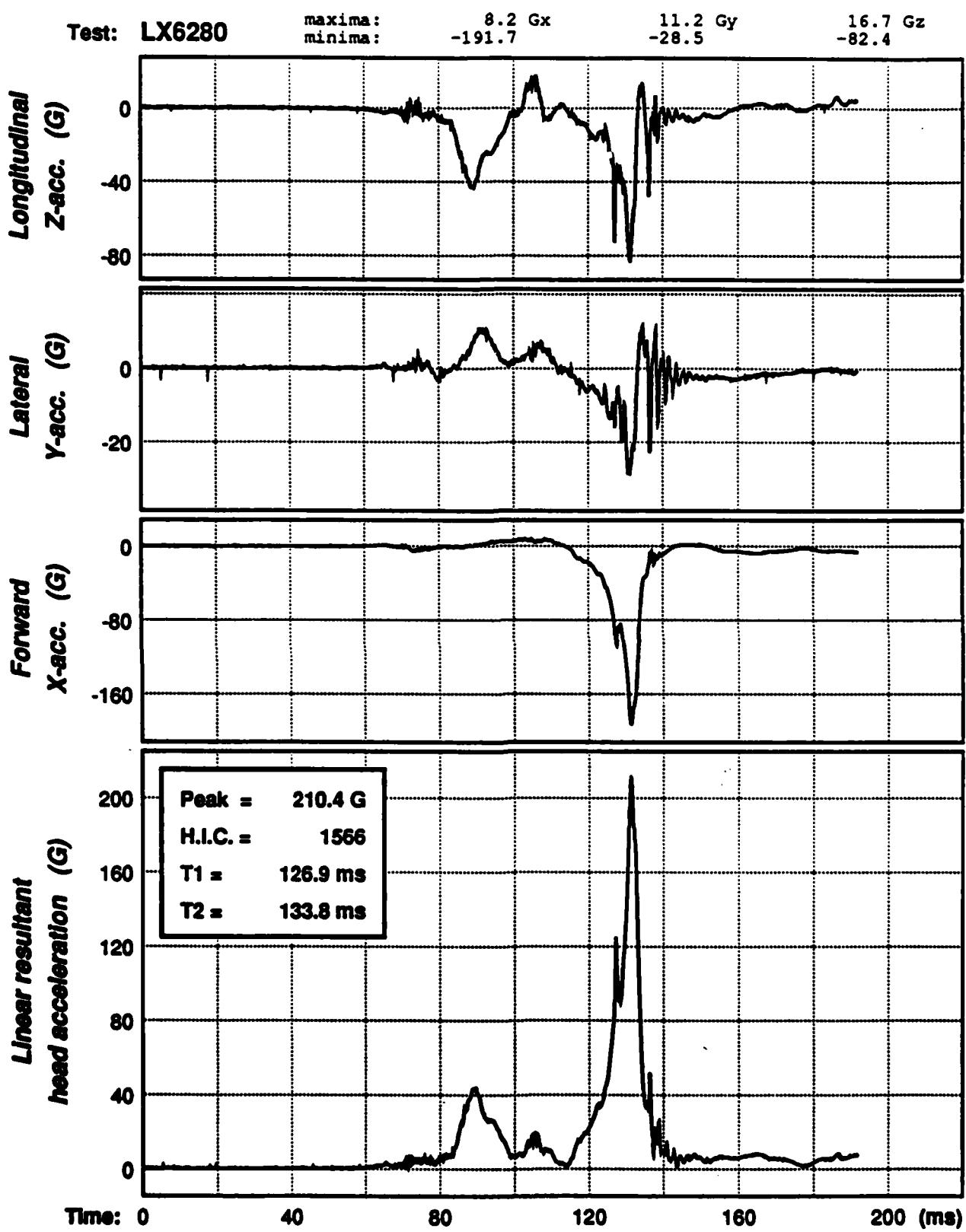


Figure C-18. Three components and resultant of the linear head acceleration for test LX6280.

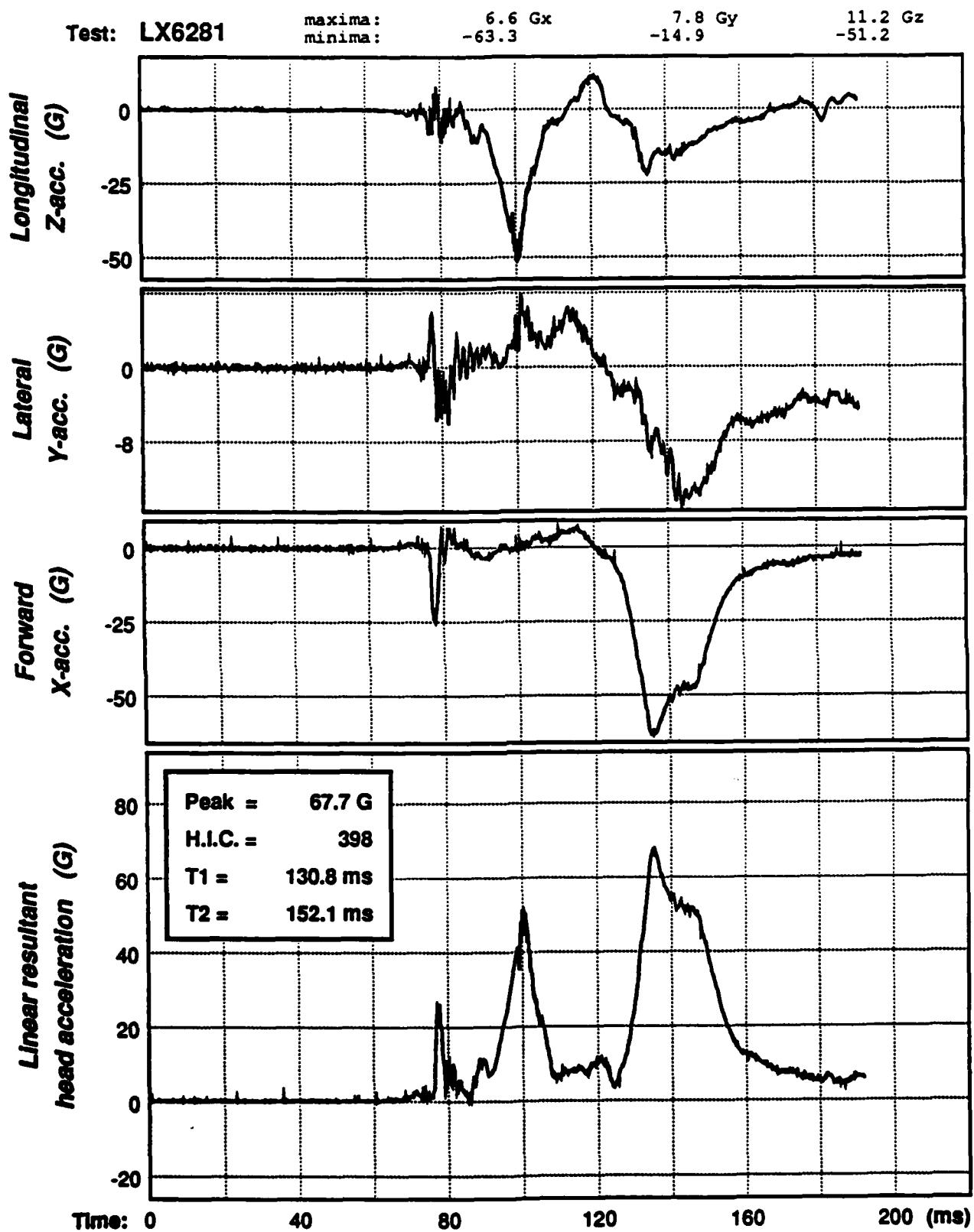


Figure C-19. Three components and resultant of the linear head acceleration for test LX6281.

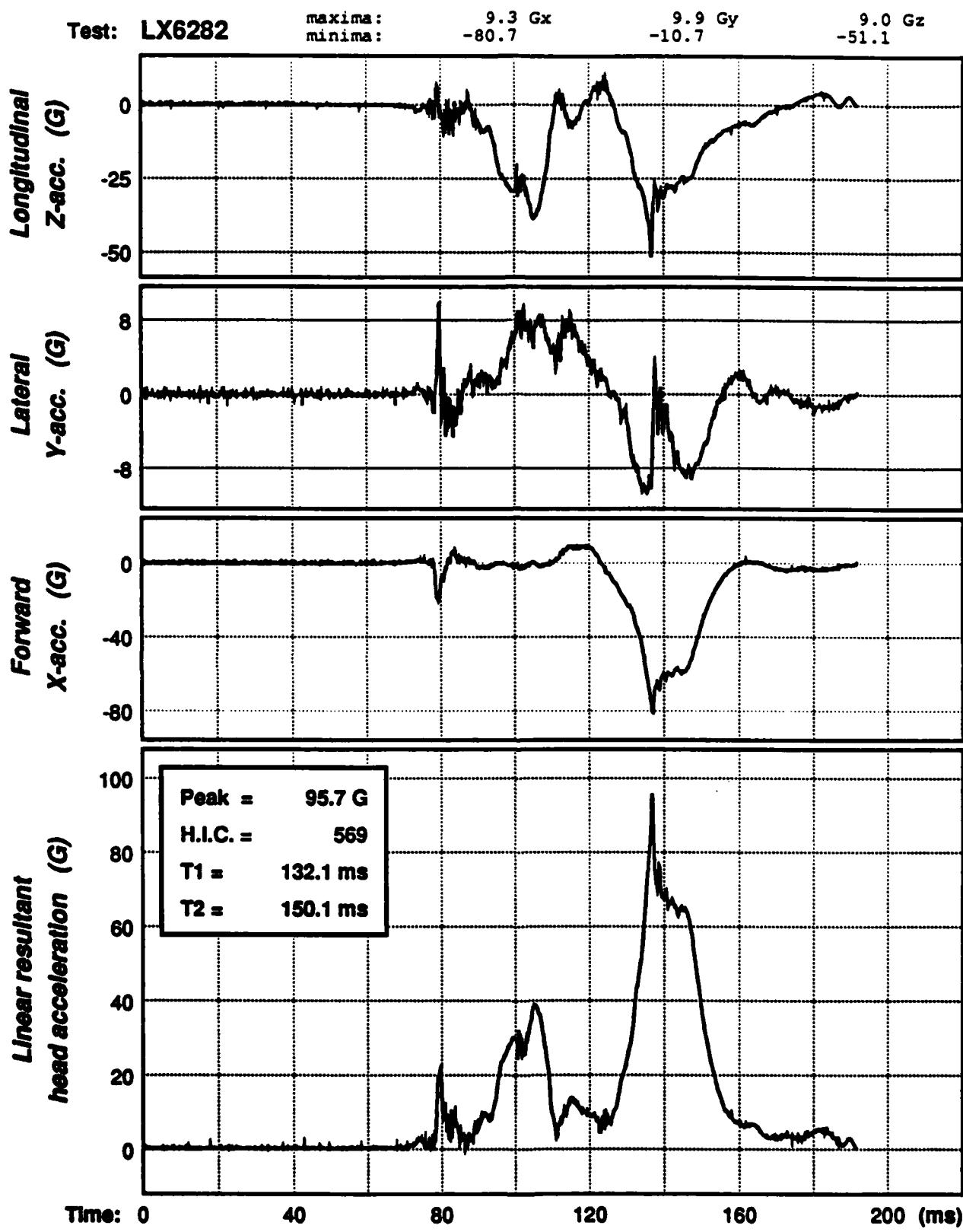


Figure C-20. Three components and resultant of the linear head acceleration for test LX6282.

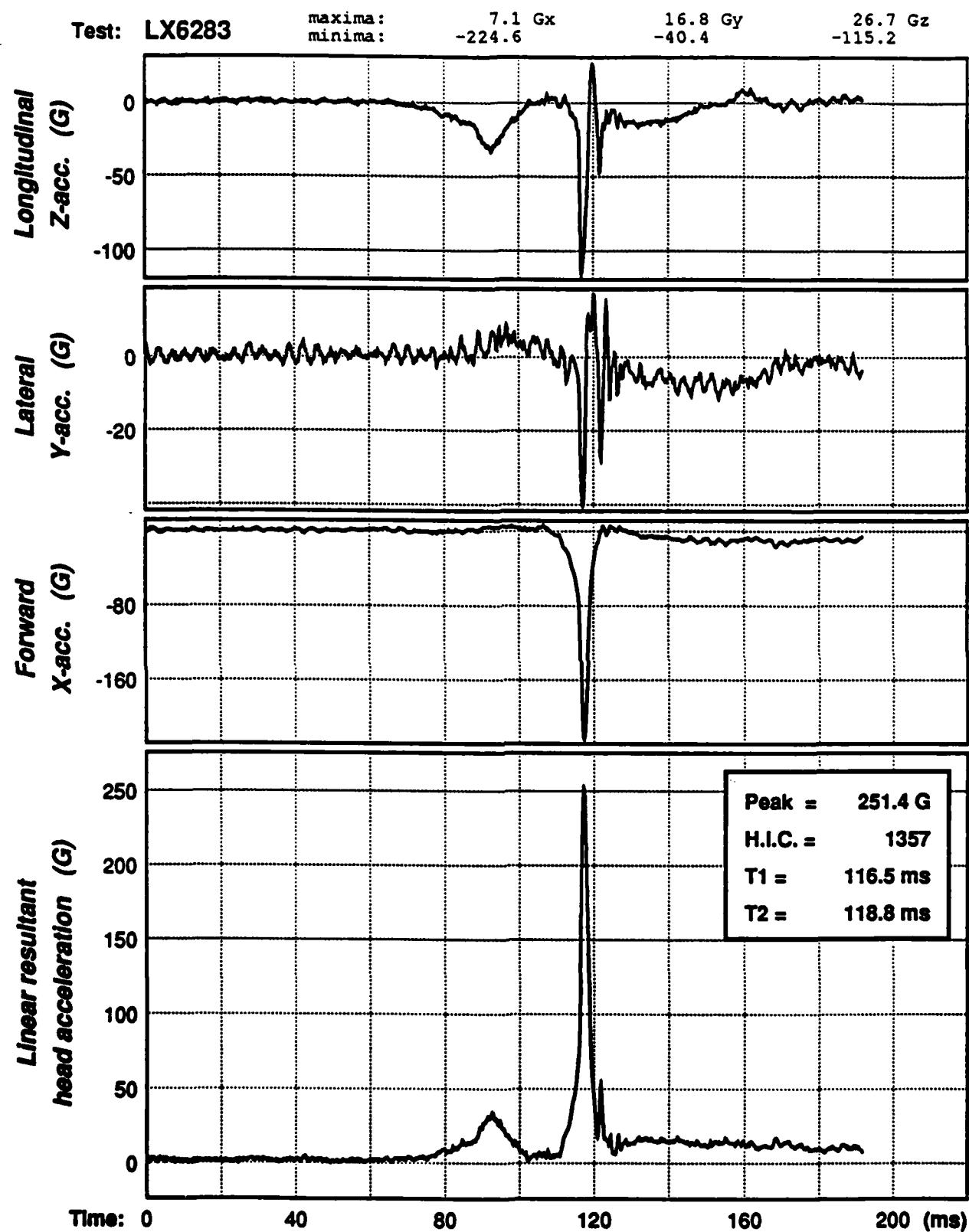


Figure C-21. Three components and resultant of the linear head acceleration for test LX6283.

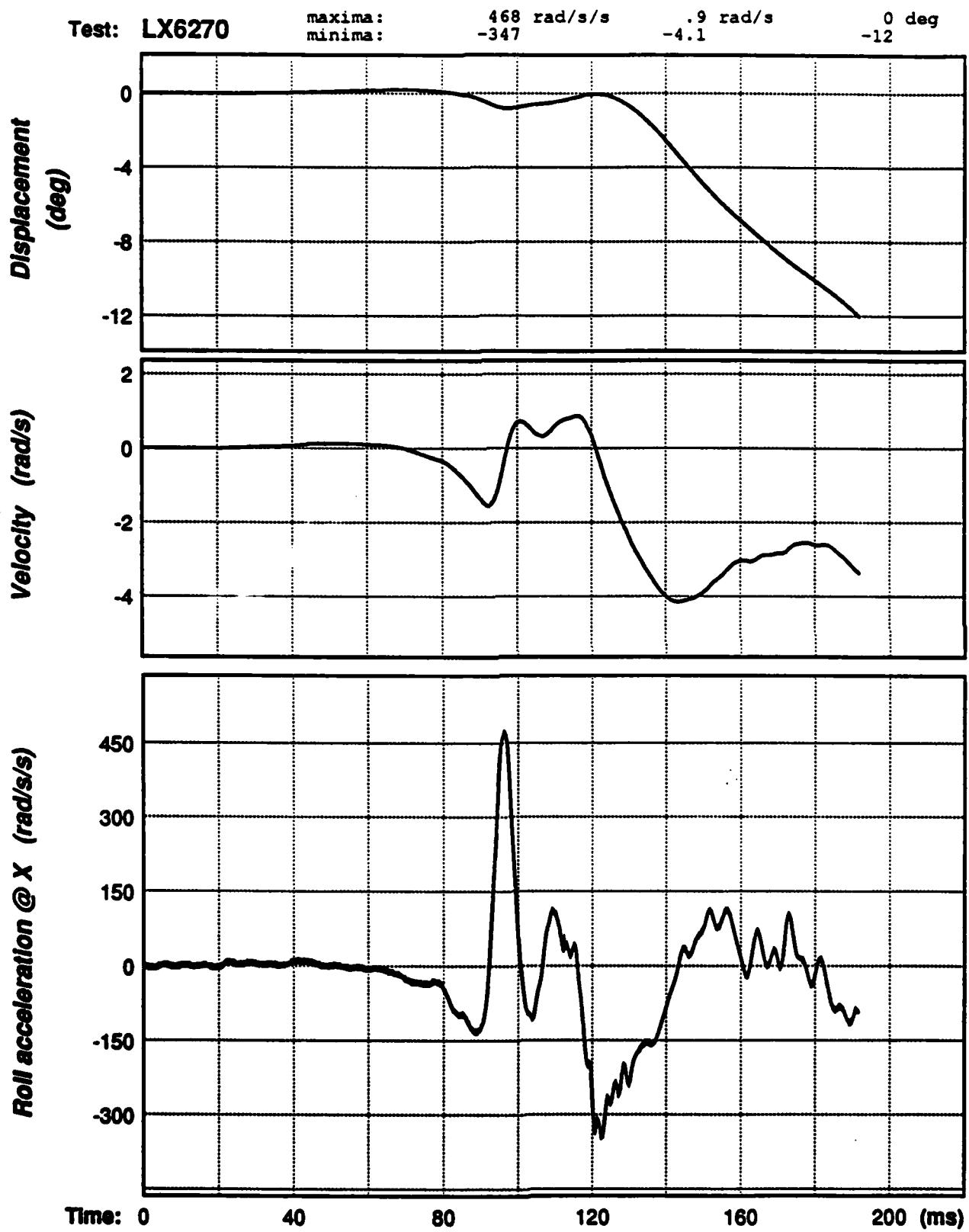


Figure C-22. Head roll angular acceleration, velocity, and displacement signals for test LX6270.

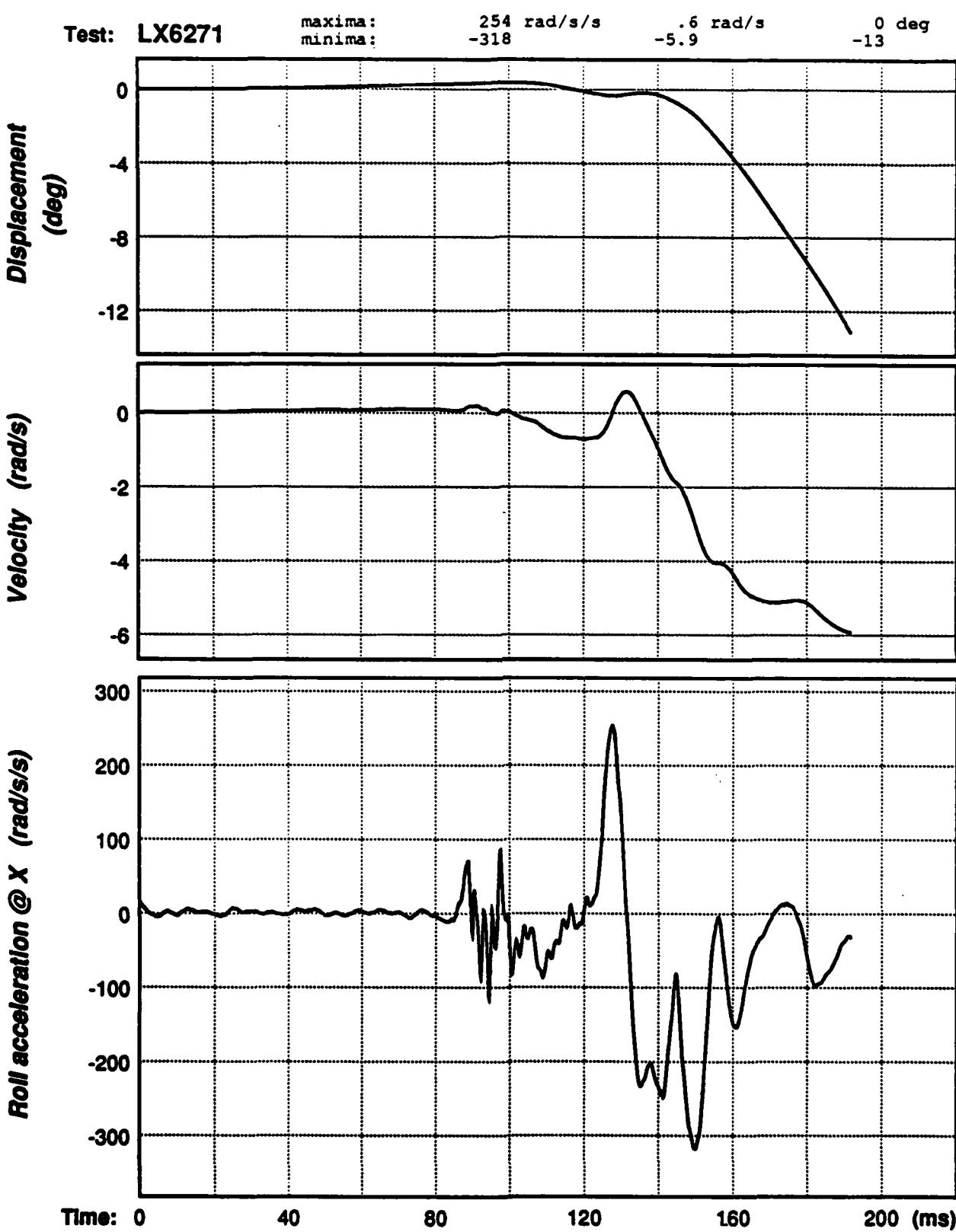


Figure C-23. Head roll angular acceleration, velocity, and displacement signals for test LX6271.

Test: LX6272 maxima: 1324 rad/s/s 3.3 rad/s 0 deg
 minima: -515 -7.8 -22

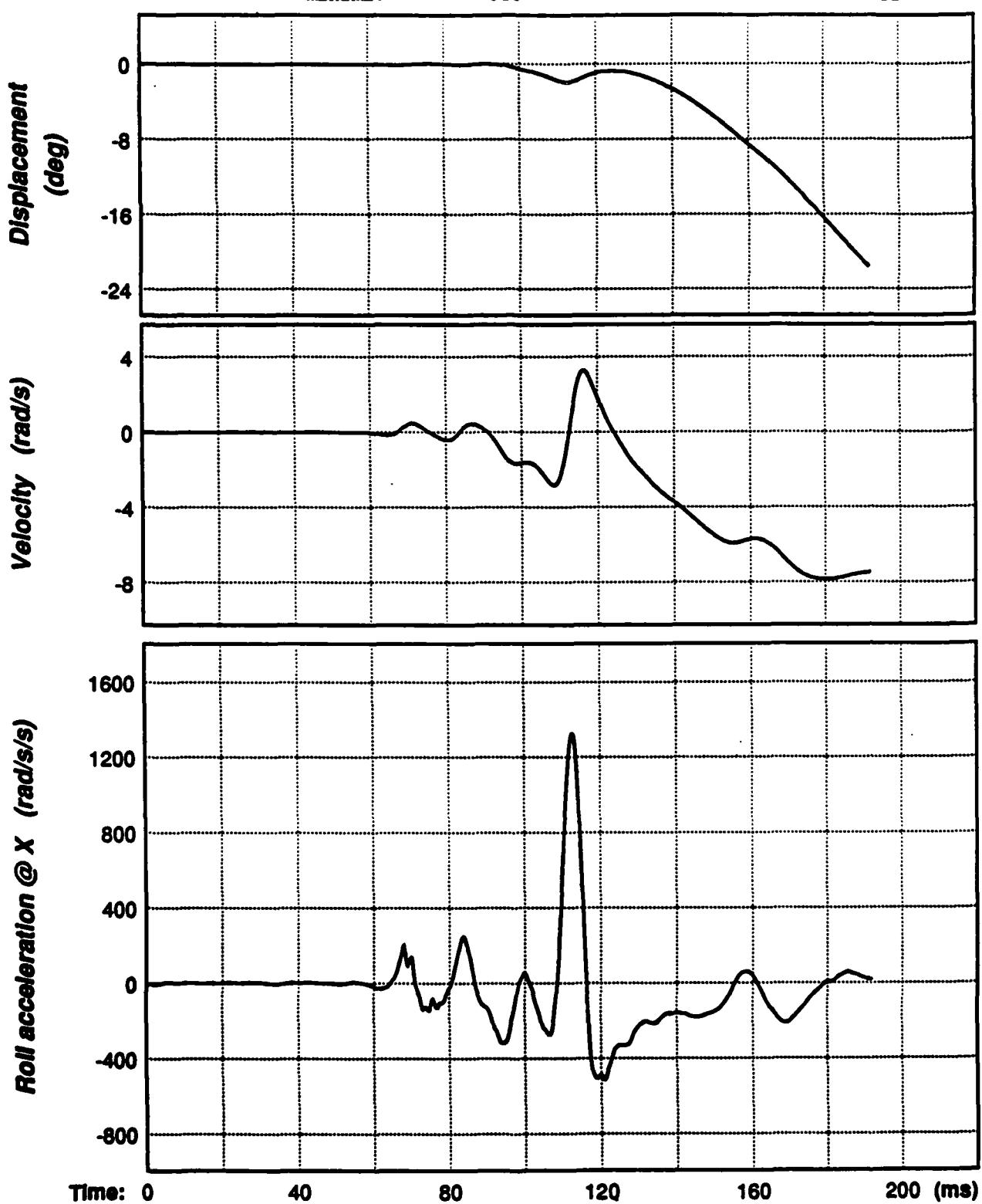


Figure C-24. Head roll angular acceleration, velocity, and displacement signals for test LX6272.

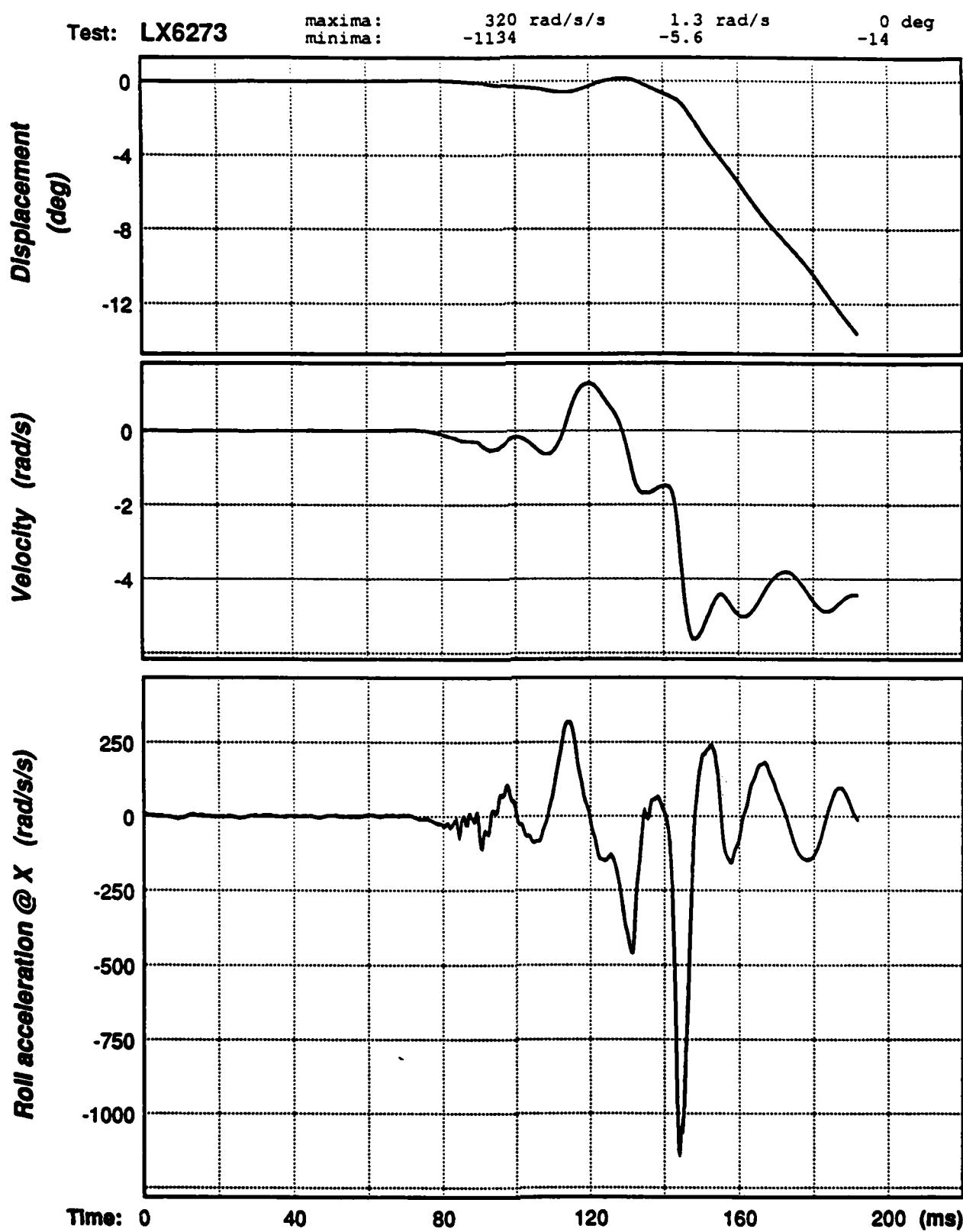


Figure C-25. Head roll angular acceleration, velocity, and displacement signals for test LX6273.

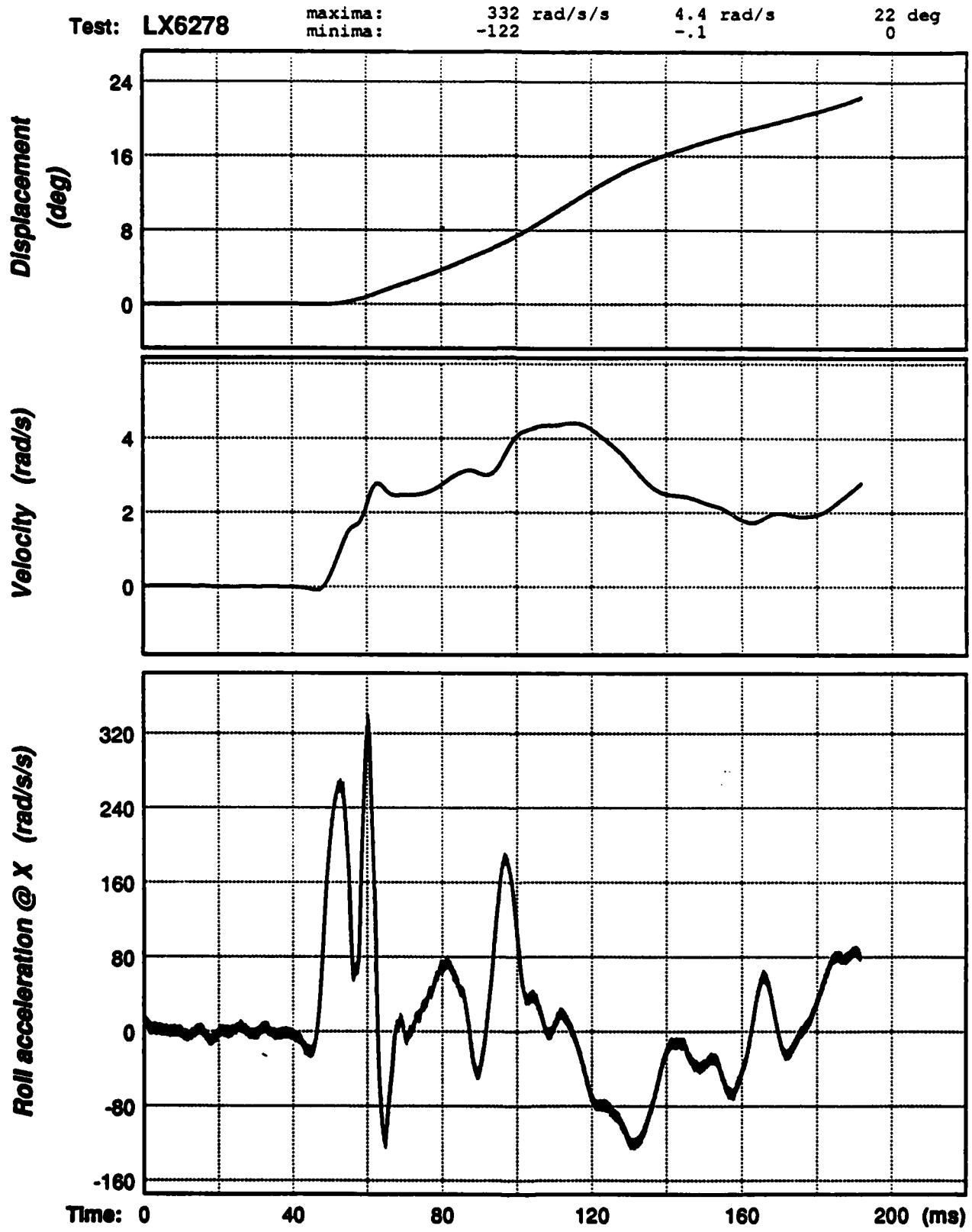


Figure C-26. Head roll angular acceleration, velocity, and displacement signals for test LX6278.

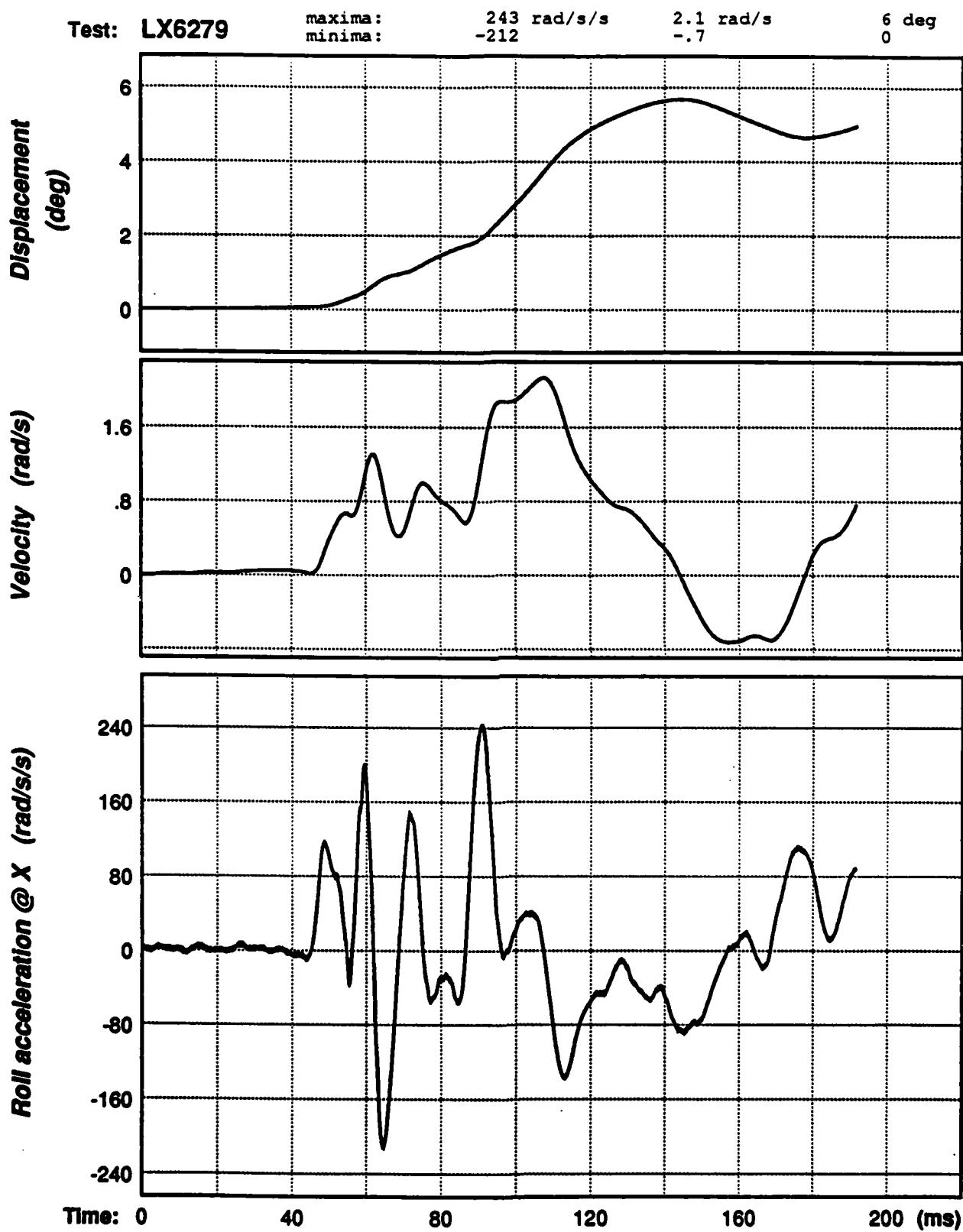


Figure C-27. Head roll angular acceleration, velocity, and displacement signals for test LX6279.

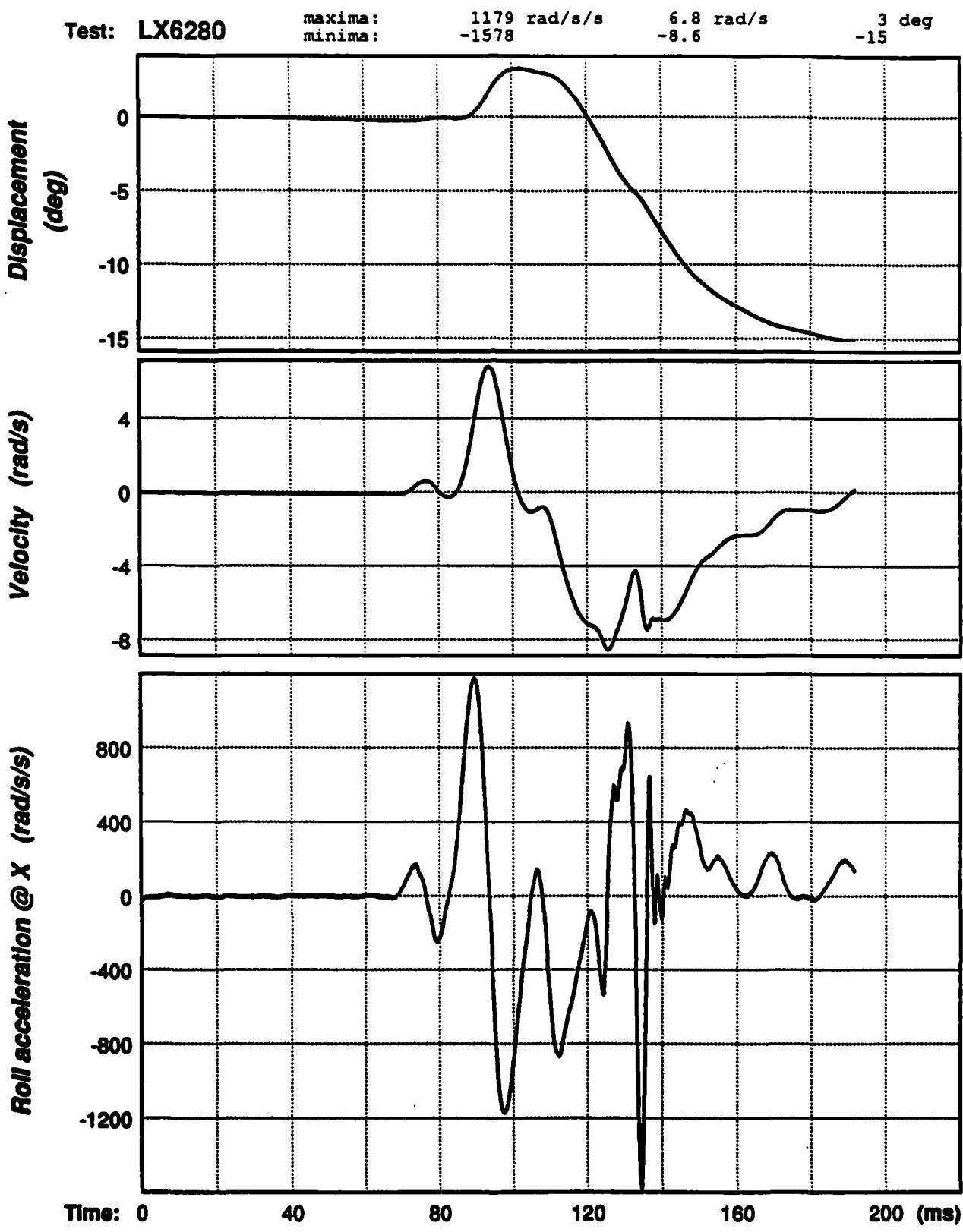


Figure C-28. Head roll angular acceleration, velocity, and displacement signals for test LX6280.

Test: LX6281 maxima: 563 rad/s/s 4.5 rad/s 2 deg
 minima: -754 -10.3 -23

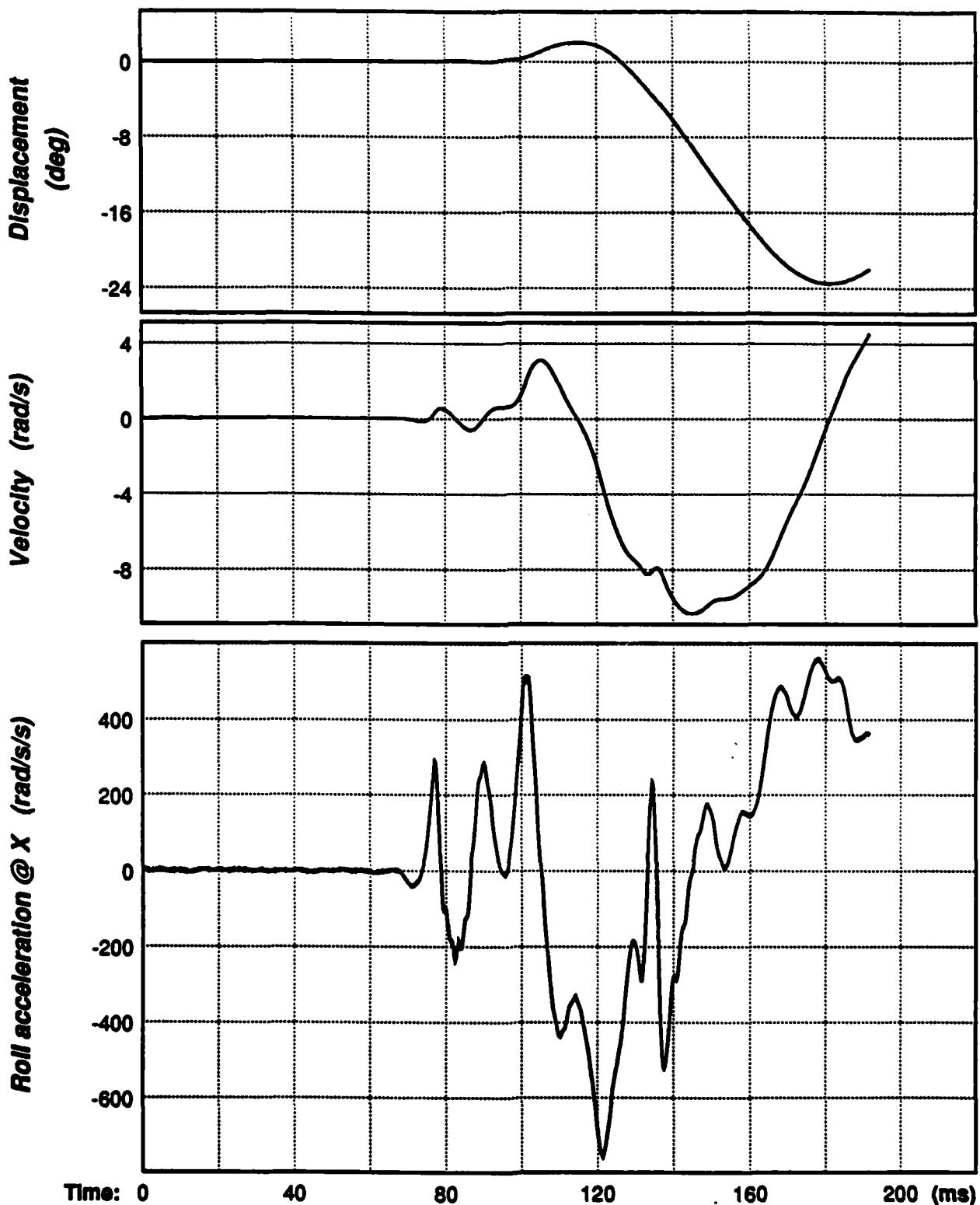


Figure C-29. Head roll angular acceleration, velocity, and displacement signals for test LX6281.

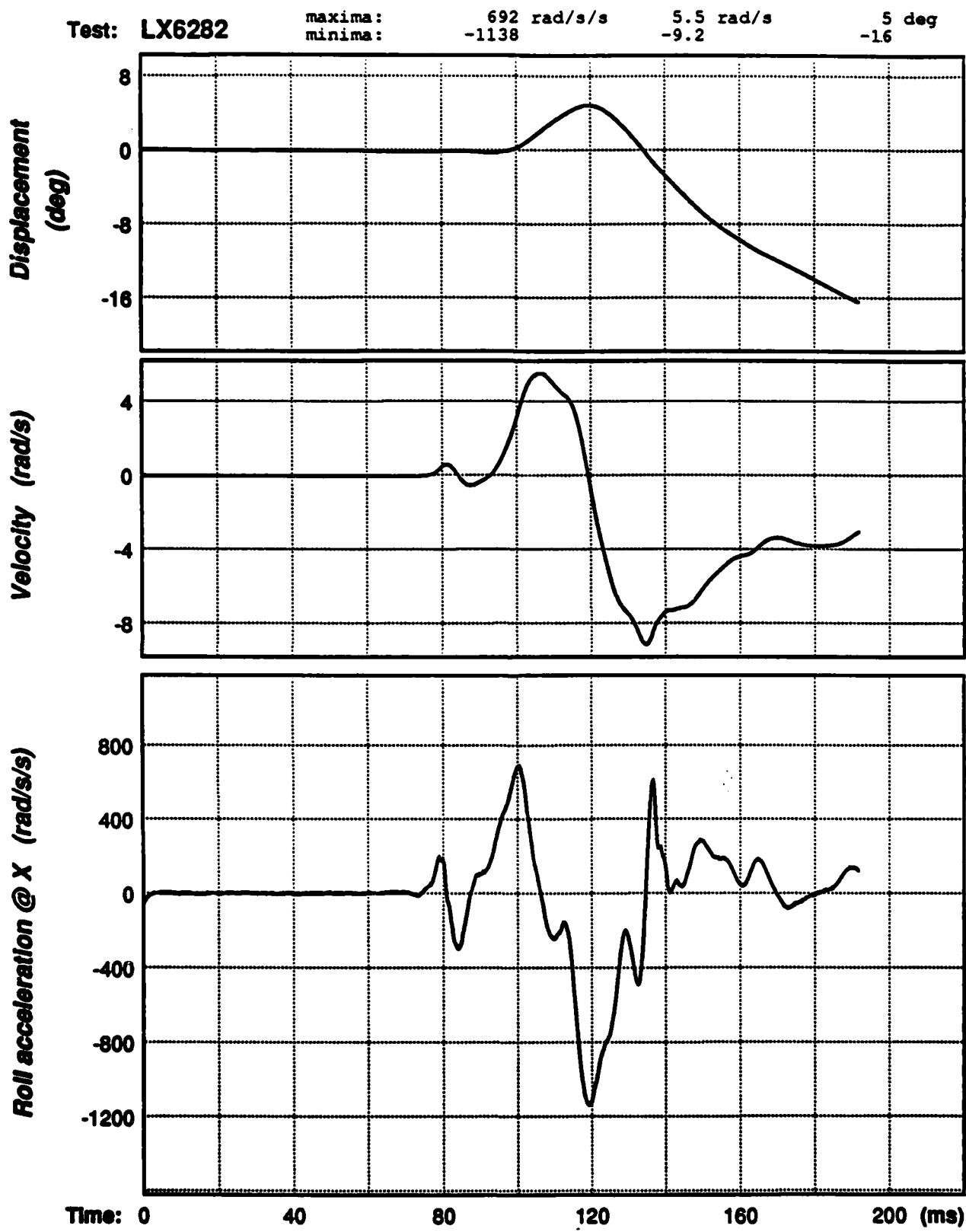


Figure C-30. Head roll angular acceleration, velocity, and displacement signals for test LX6282.

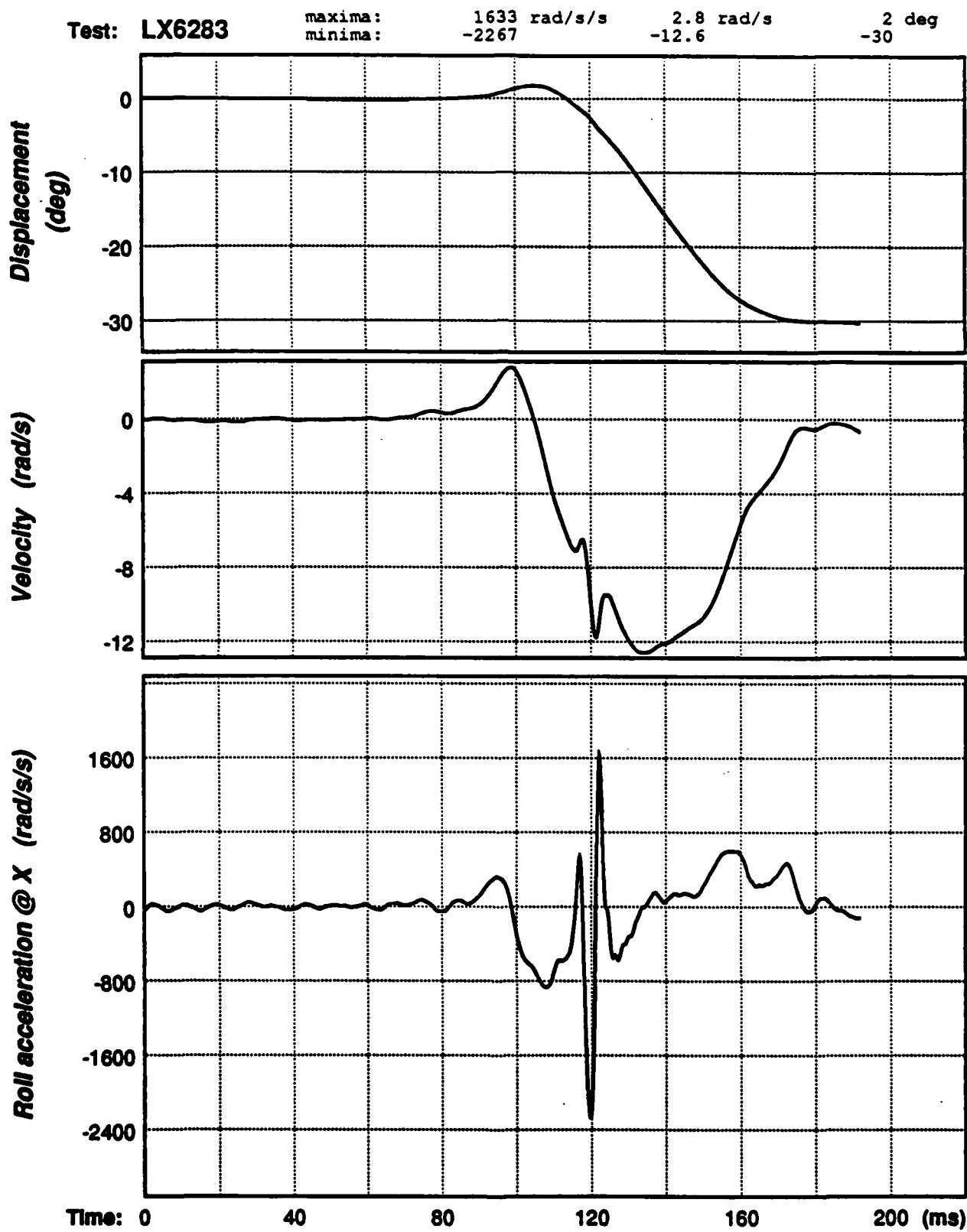


Figure C-31. Head roll angular acceleration, velocity, and displacement signals for test LX6283.

Test: LX6270

maxima:
minima:

1612 rad/s/s
-2227

9.3 rad/s
-20.2

9 deg
-39

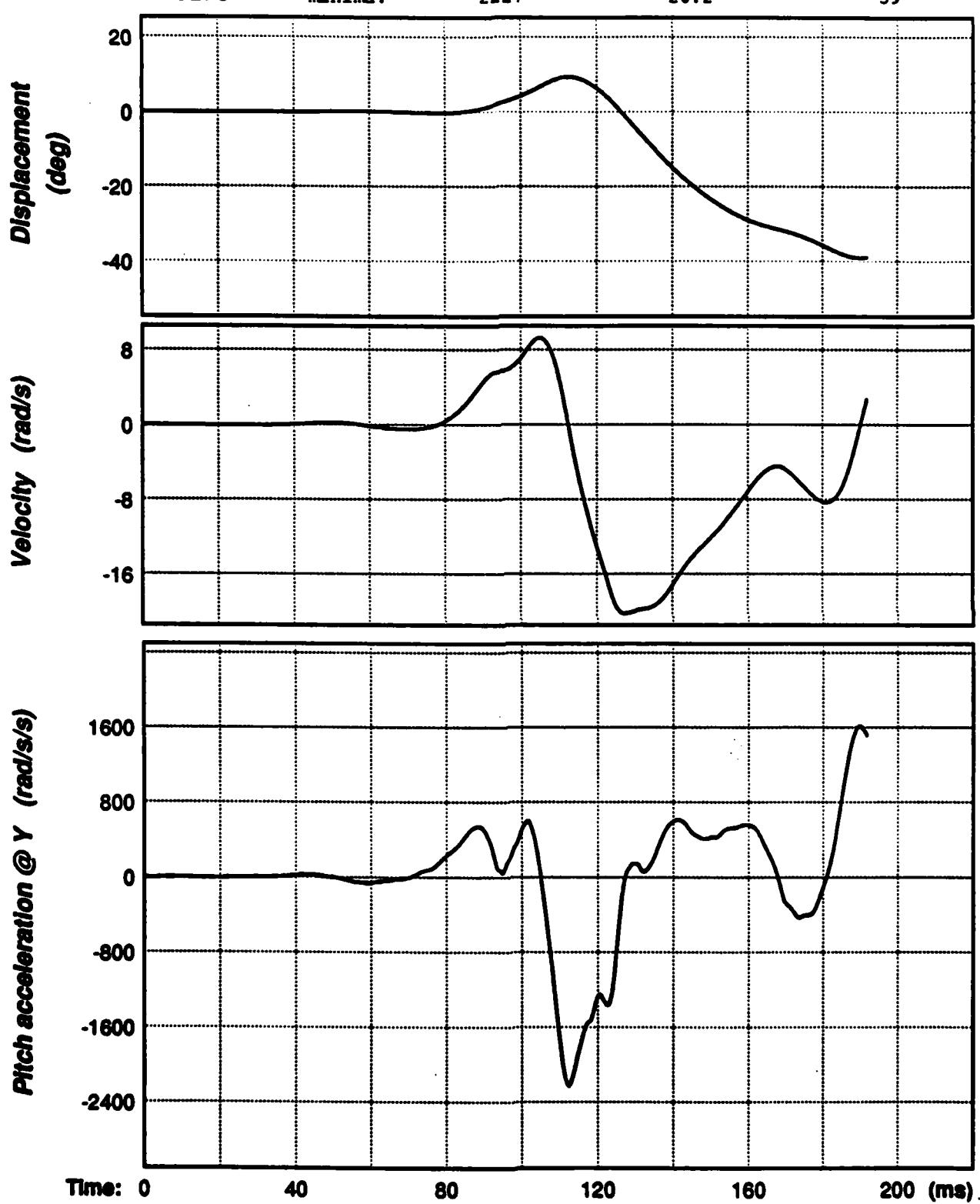


Figure C-32. Head pitch angular acceleration, velocity, and displacement signals for test LX6270.

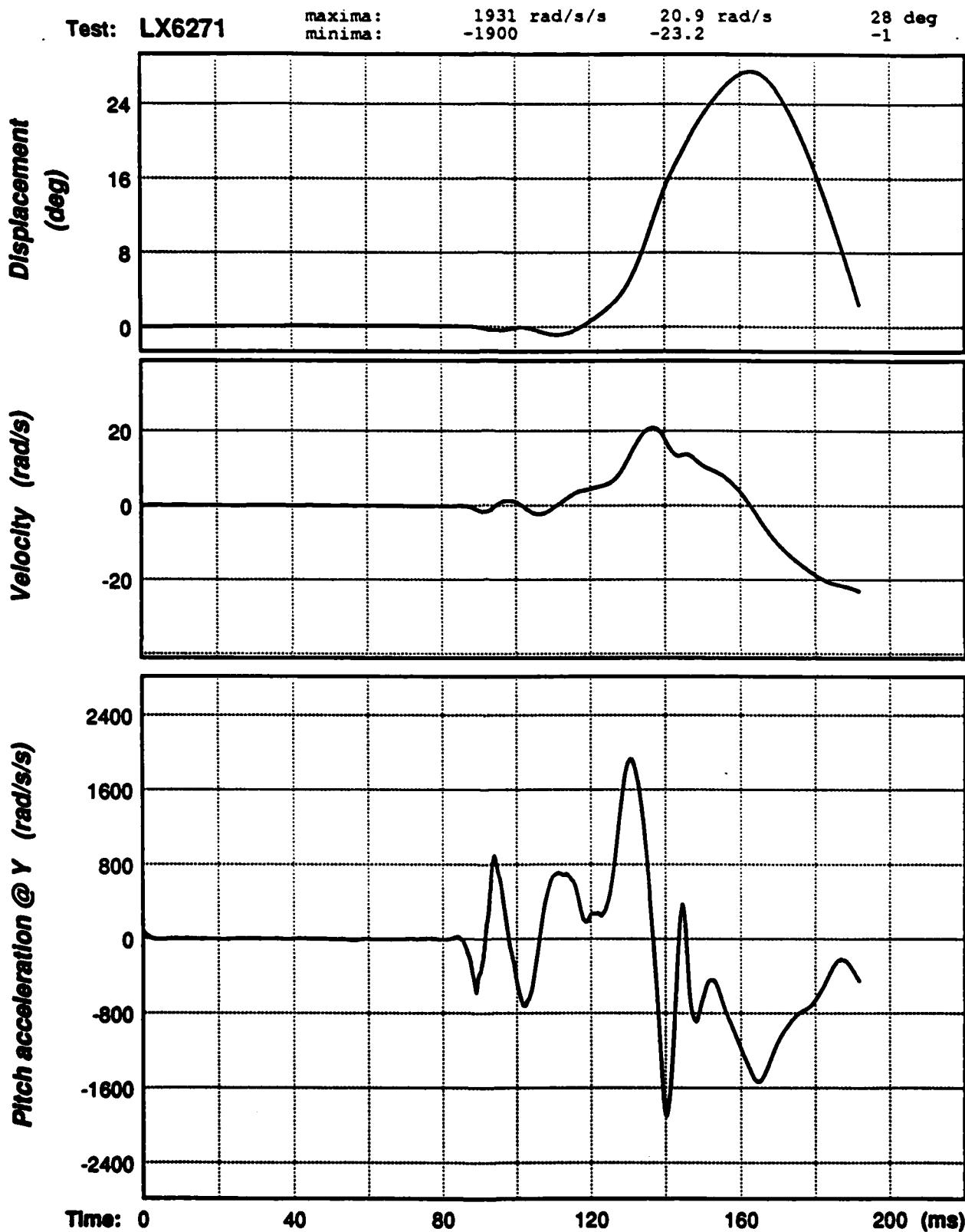


Figure C-33. Head pitch angular acceleration, velocity, and displacement signals for test LX6271.

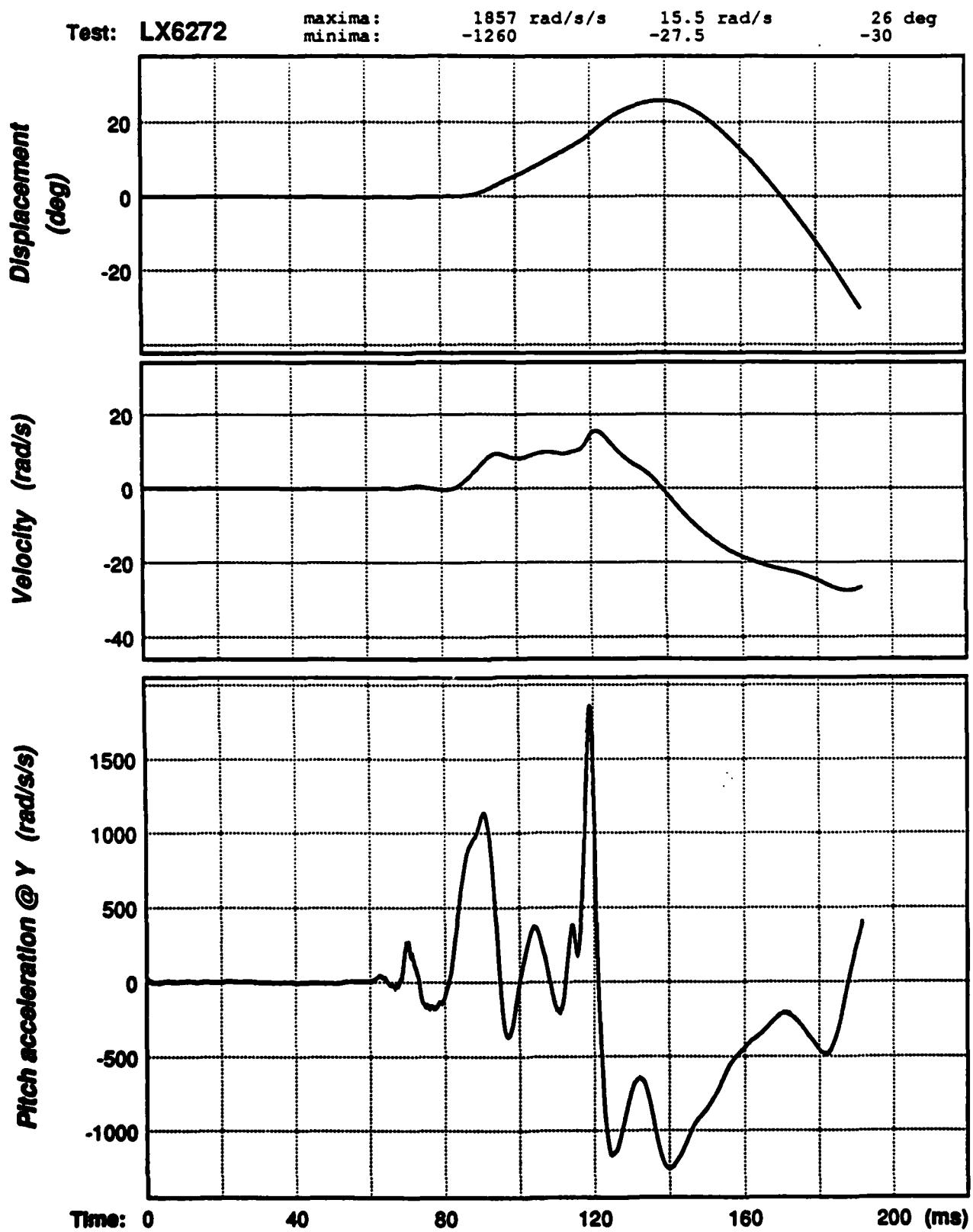


Figure C-34. Head pitch angular acceleration, velocity, and displacement signals for test LX6272.

Test: LX6273

maxima: 30656 rad/s/s
minima: -1926 .0
1383.9 rad/s
1980 deg
0

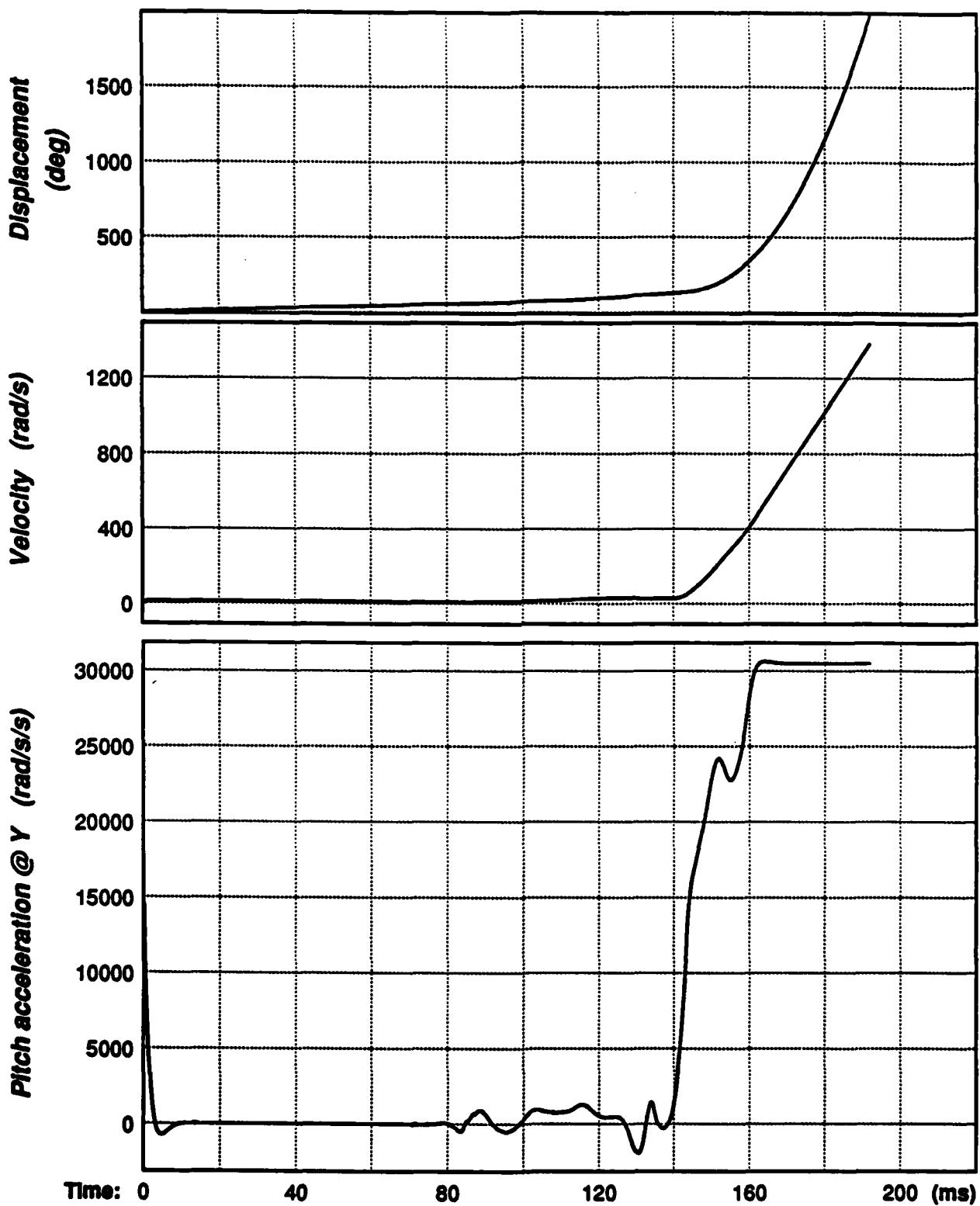


Figure C-35. Head pitch angular acceleration, velocity, and displacement signals for test LX6273.

Test: LX6278

maxima:
minima:

775 rad/s/s
-722

7.6 rad/s
-.4

36 deg
0

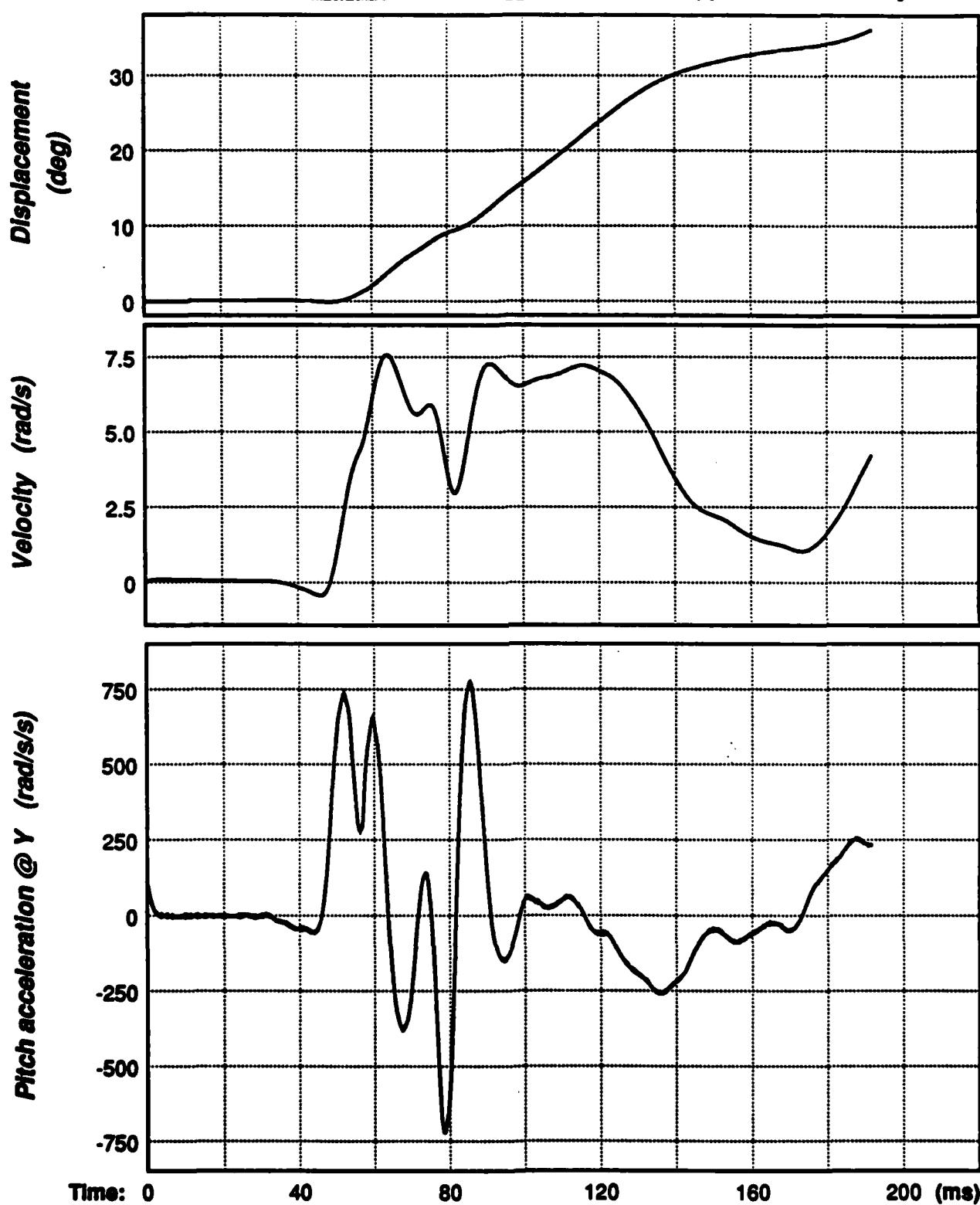


Figure C-36. Head pitch angular acceleration, velocity, and displacement signals for test LX6278.

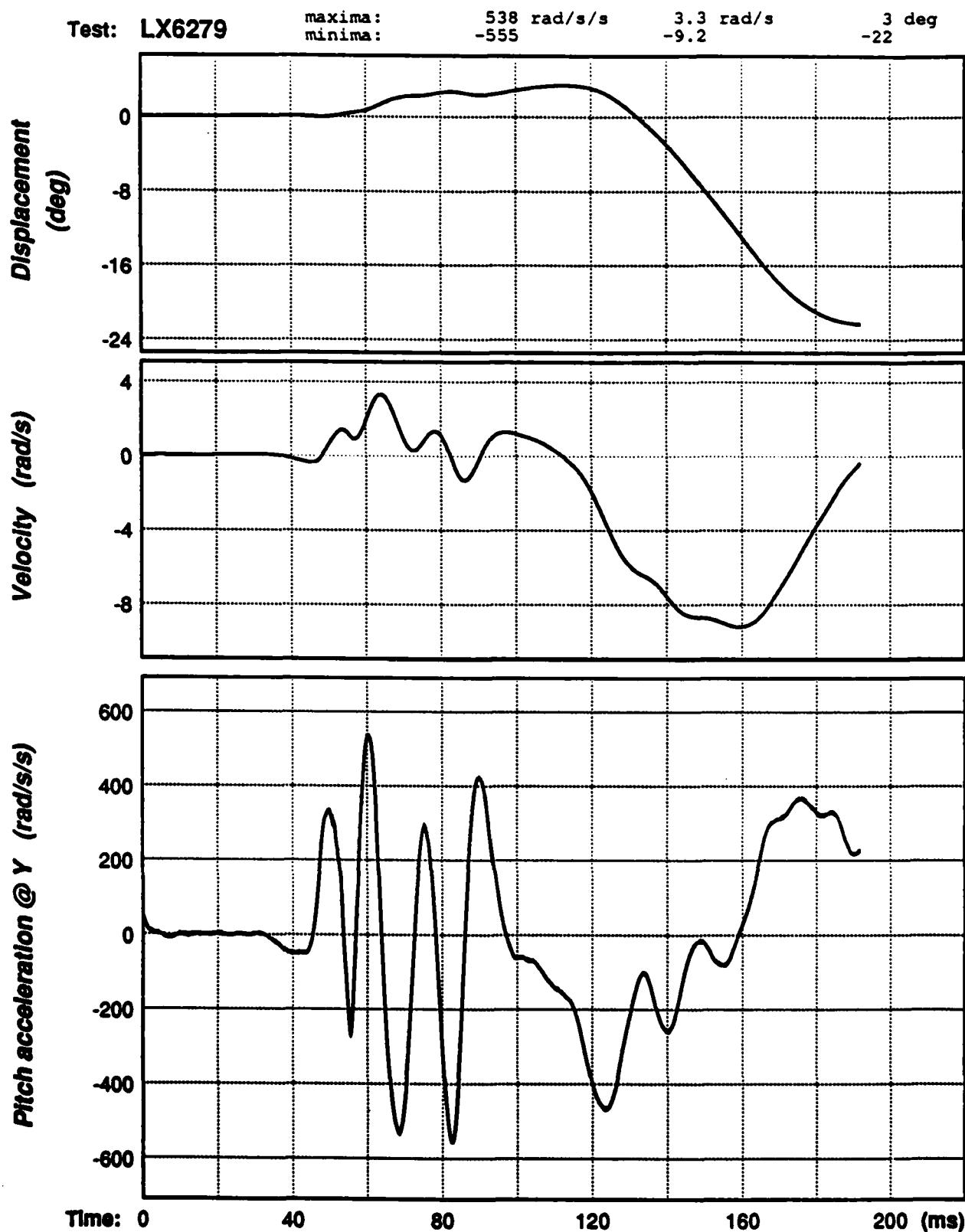


Figure C-37. Head pitch angular acceleration, velocity, and displacement signals for test LX6279.

Test: LX6280

maxima:
minima:

7304 rad/s/s
-4112

8.2 rad/s
-33.5

7 deg
-28

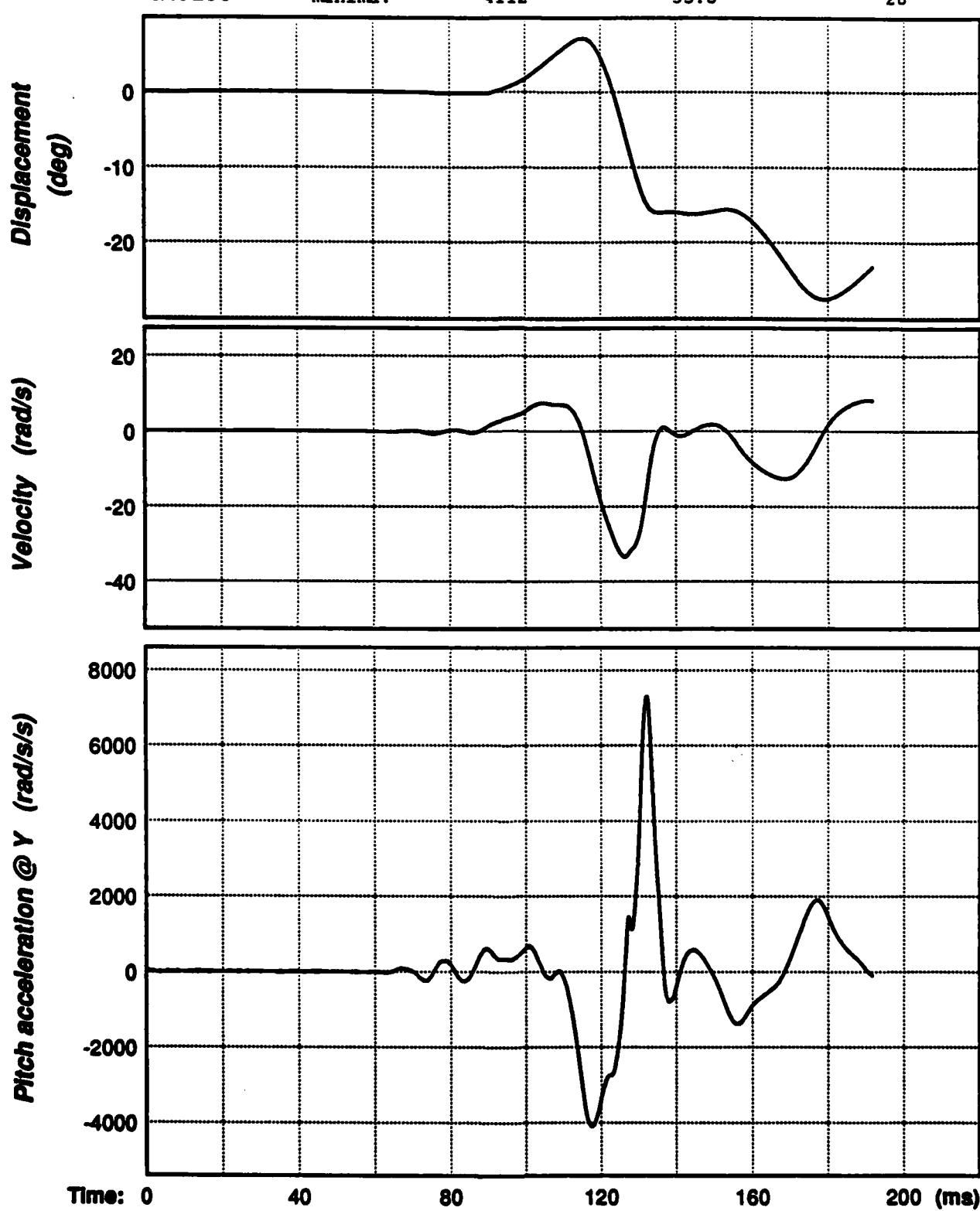


Figure C-38. Head pitch angular acceleration, velocity, and displacement signals for test LX6280.

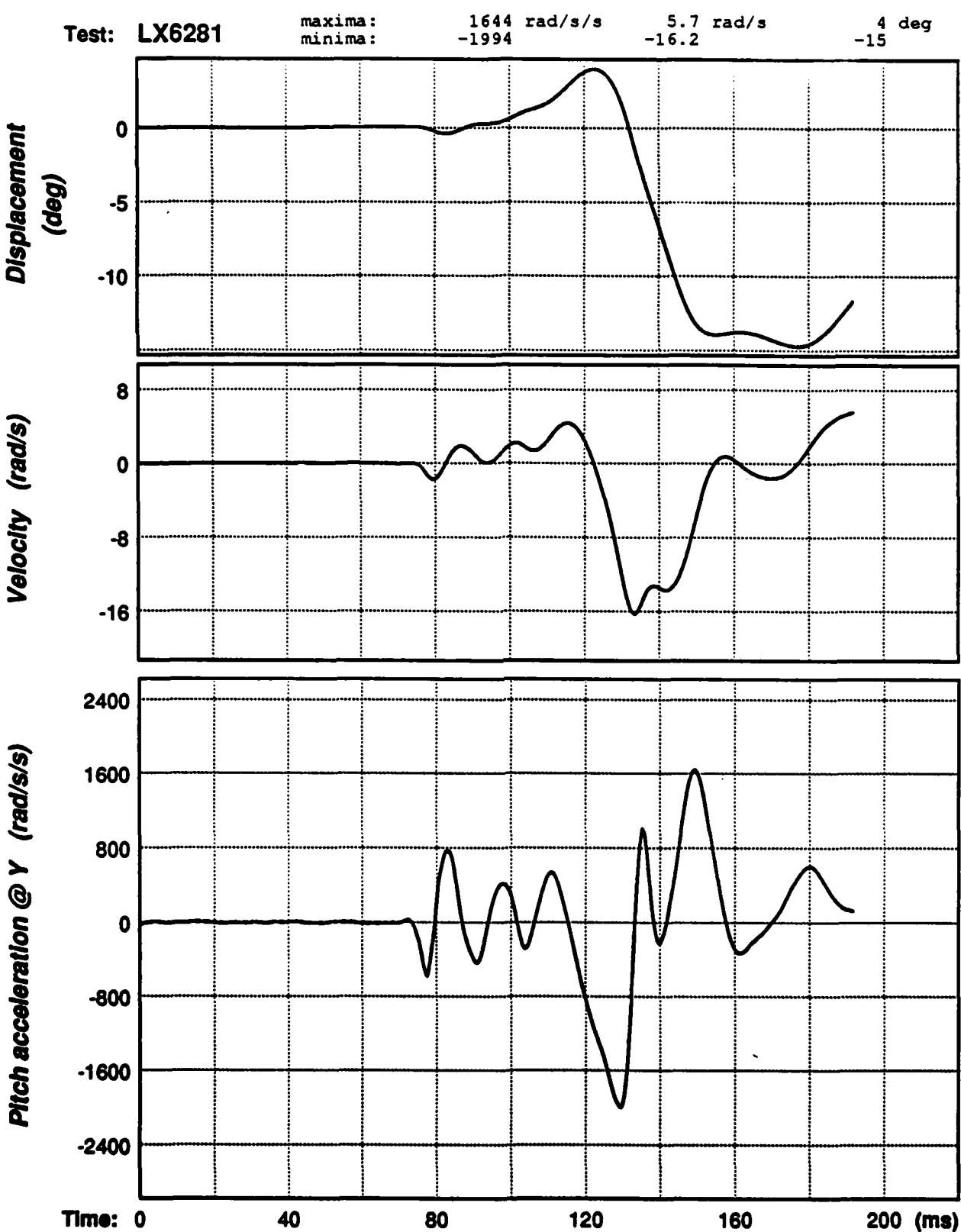


Figure C-39. Head pitch angular acceleration, velocity, and displacement signals for test LX6281.

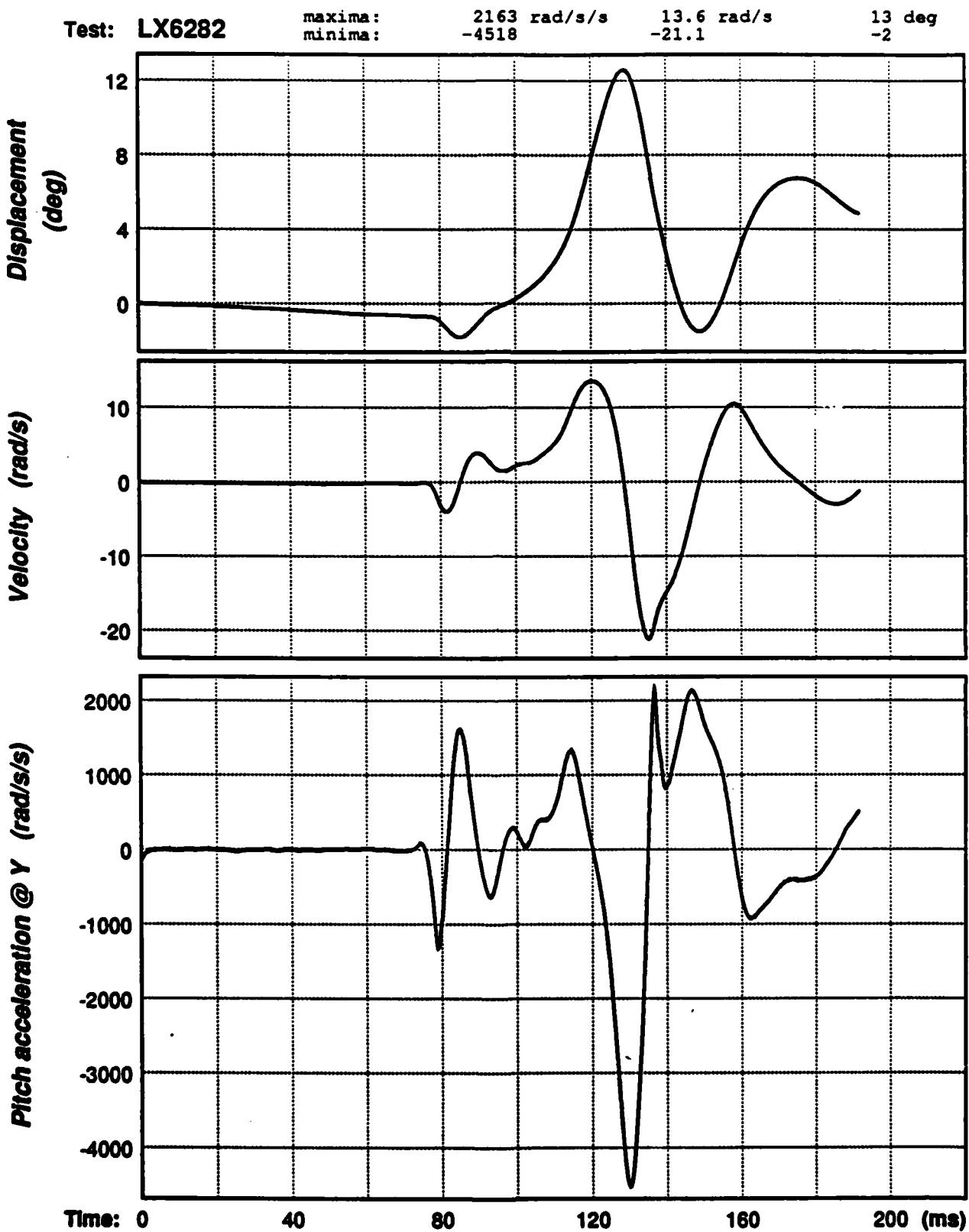


Figure C-40. Head pitch angular acceleration, velocity, and displacement signals for test LX6282.

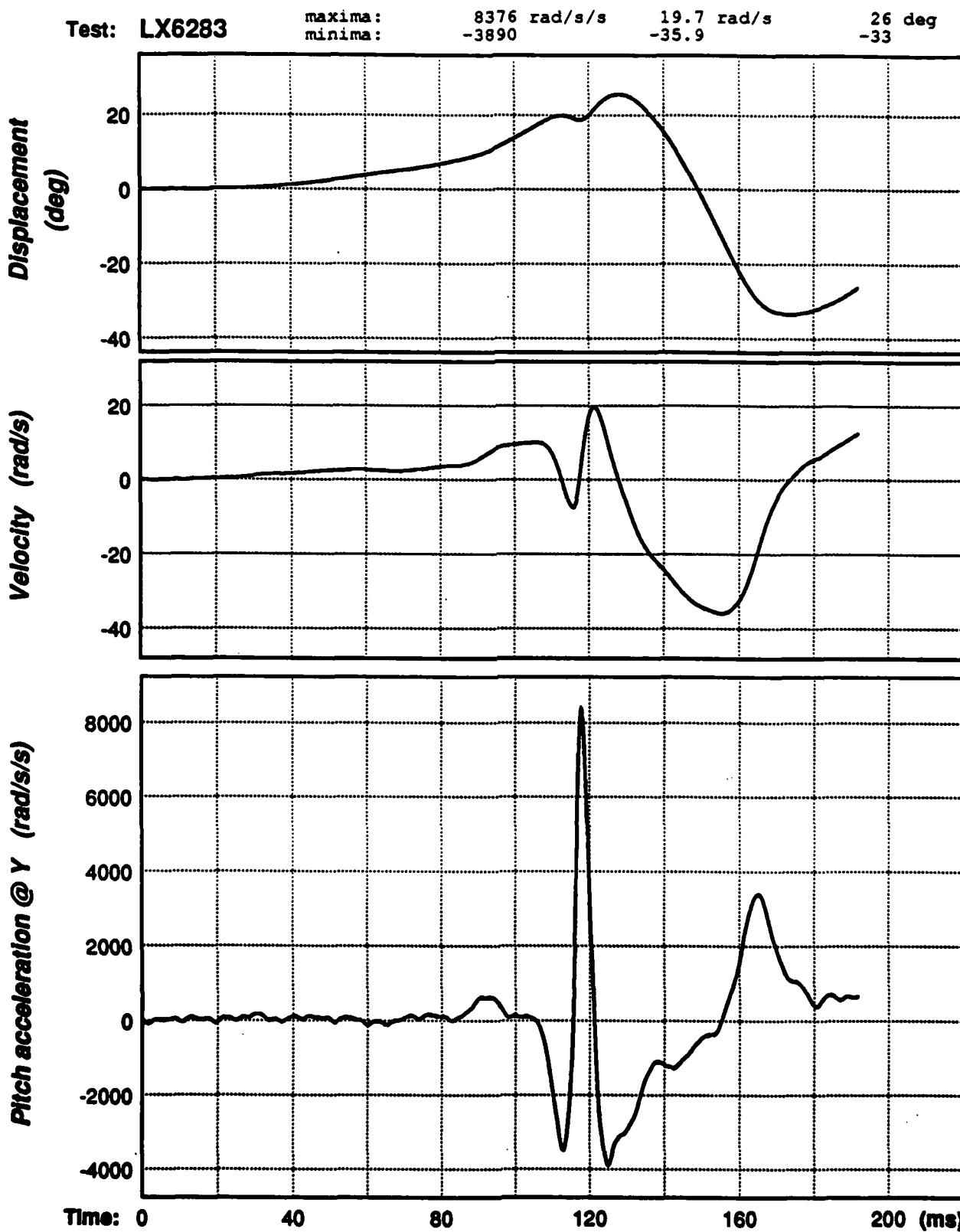


Figure C-41. Head pitch angular acceleration, velocity, and displacement signals for test LX6283.

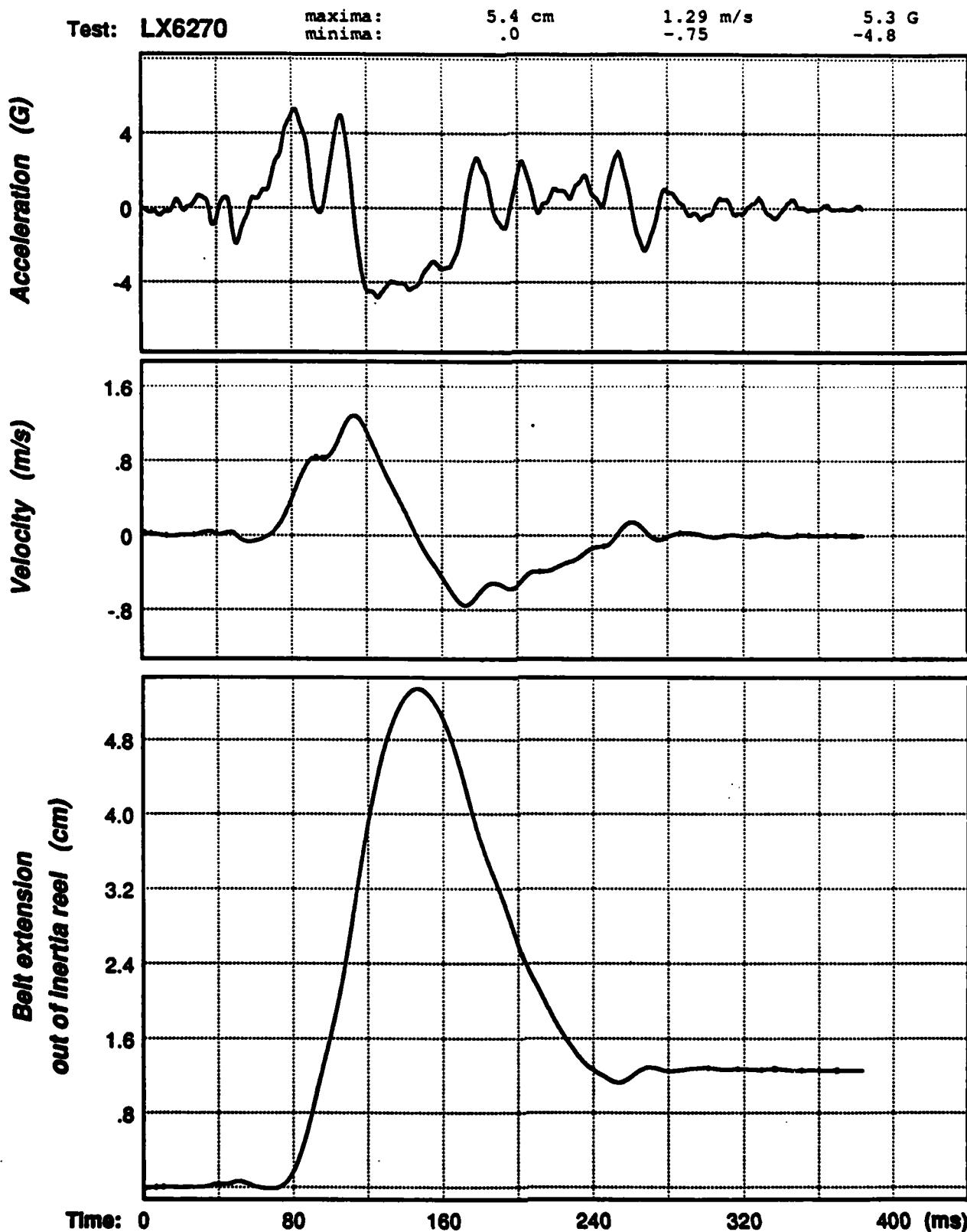


Figure C-42. Amount of belt extension and the velocity and acceleration of extension for test LX6270.

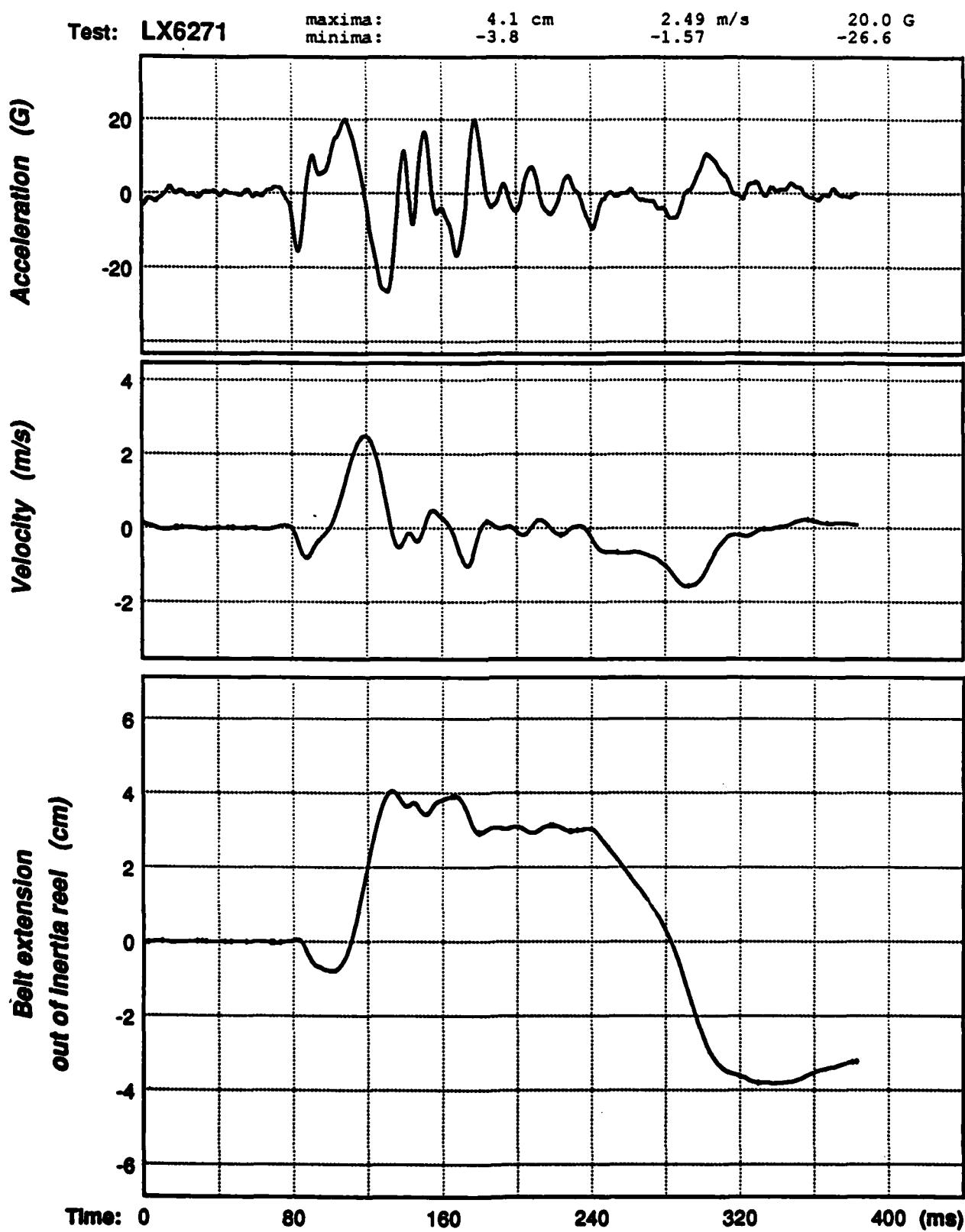


Figure C-43. Amount of belt extension and the velocity and acceleration of extension for test LX6271.

Test: LX6272

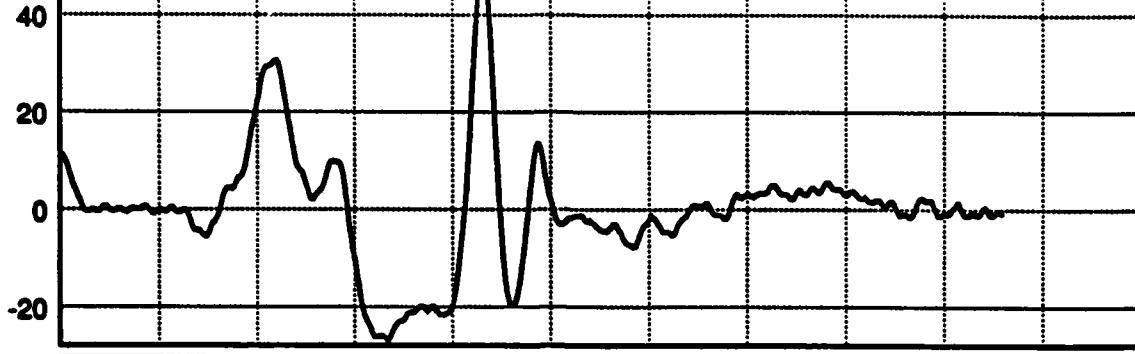
maxima:
minima:

24.8 cm
-.7

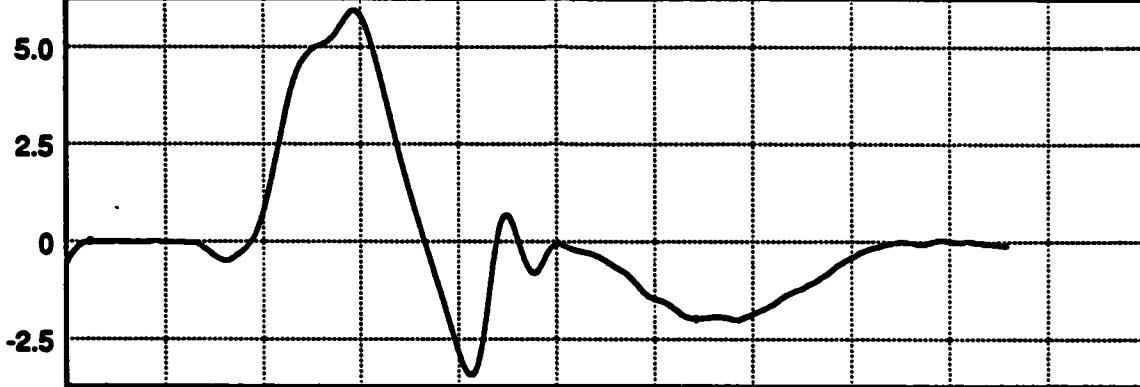
5.96 m/s
-3.41

51.0 G
-27.0

Acceleration (G)



Velocity (m/s)



Belt extension
out of inertia reel (cm)

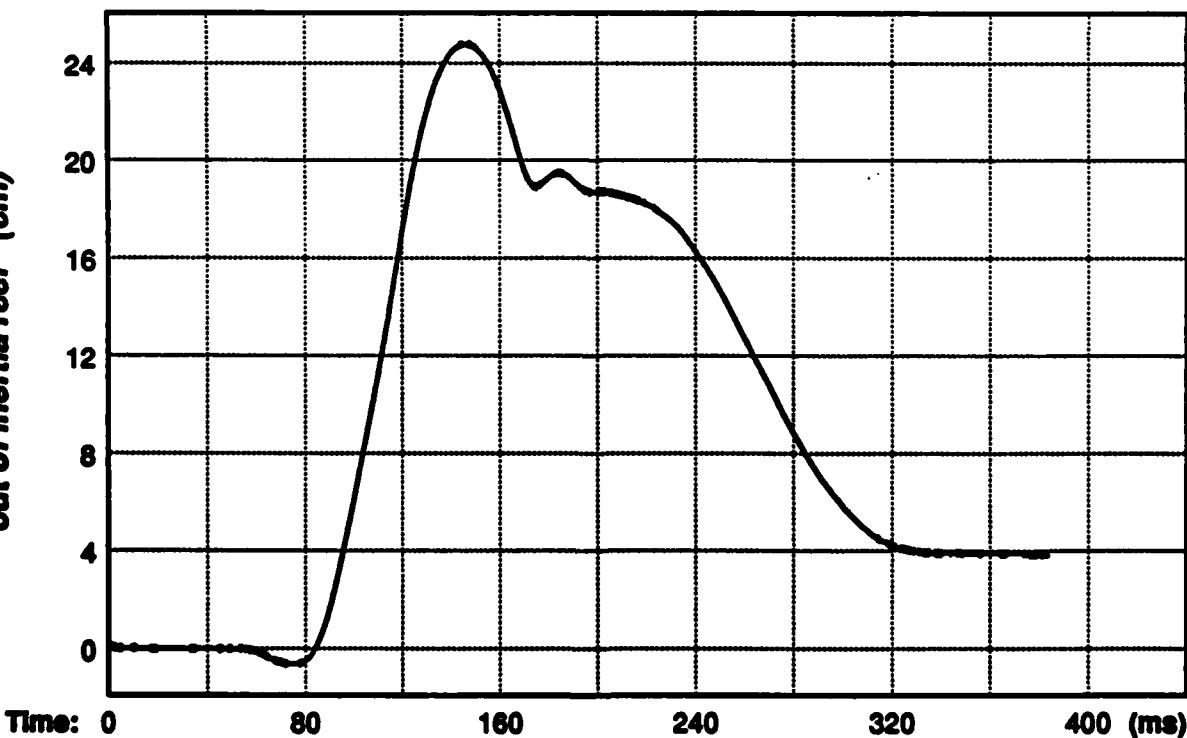


Figure C-44. Amount of belt extension and the velocity and acceleration of extension for test LX6272.

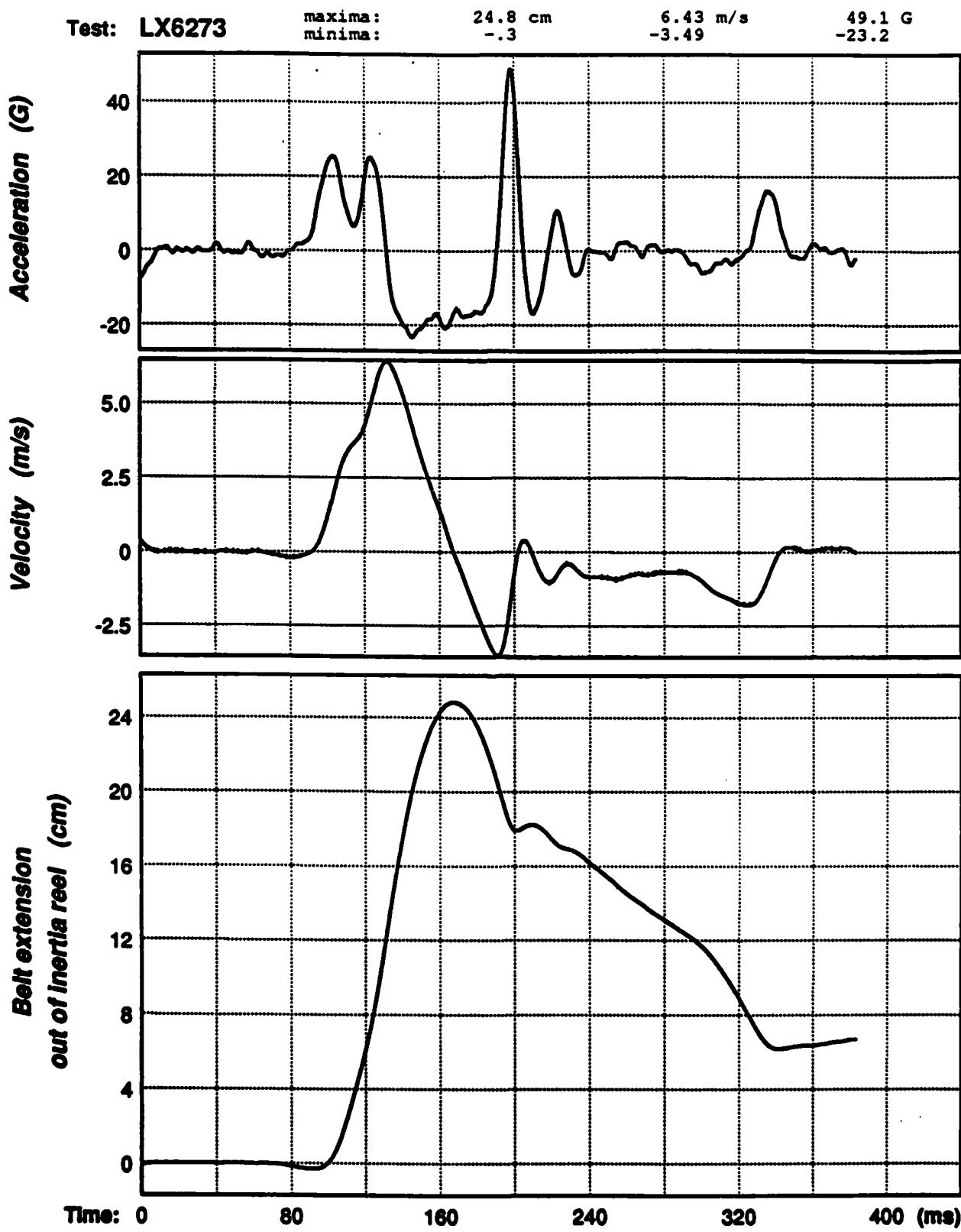


Figure C-45. Amount of belt extension and the velocity and acceleration of extension for test LX6273.

Test: LX6278 maxima: 5.5 cm 1.02 m/s 10.6 G
minima: -1.5 -1.68 -12.2

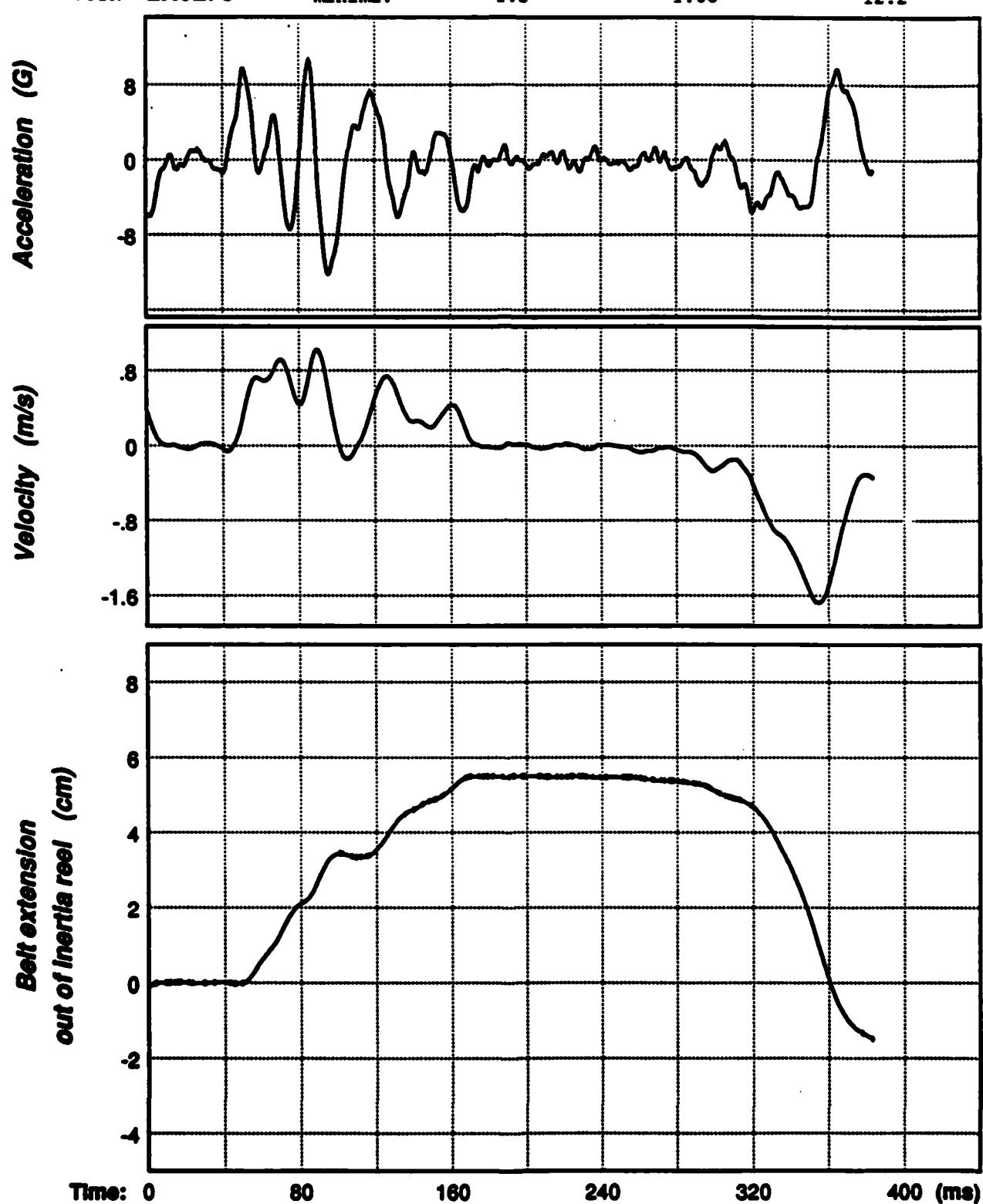


Figure C-46. Amount of belt extension and the velocity and acceleration of extension for test LX6278.

Test: LX6279

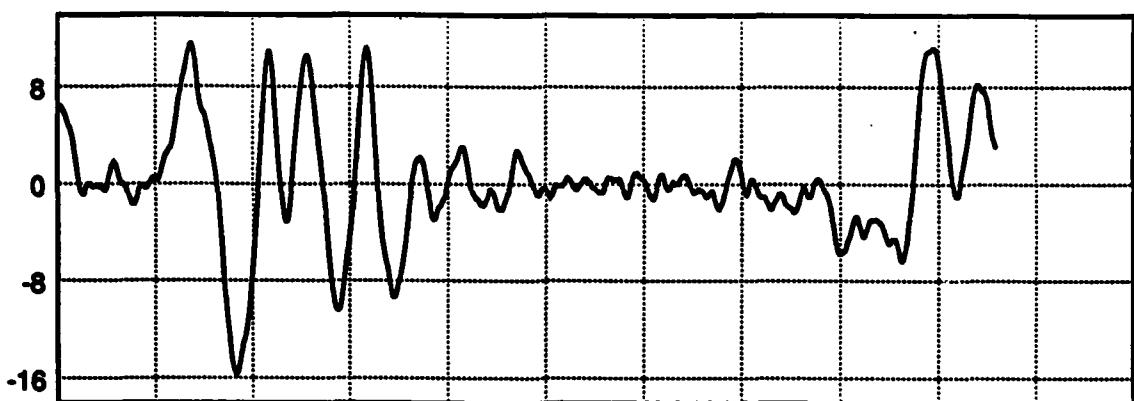
maxima:
minima:

4.9 cm
-1.6

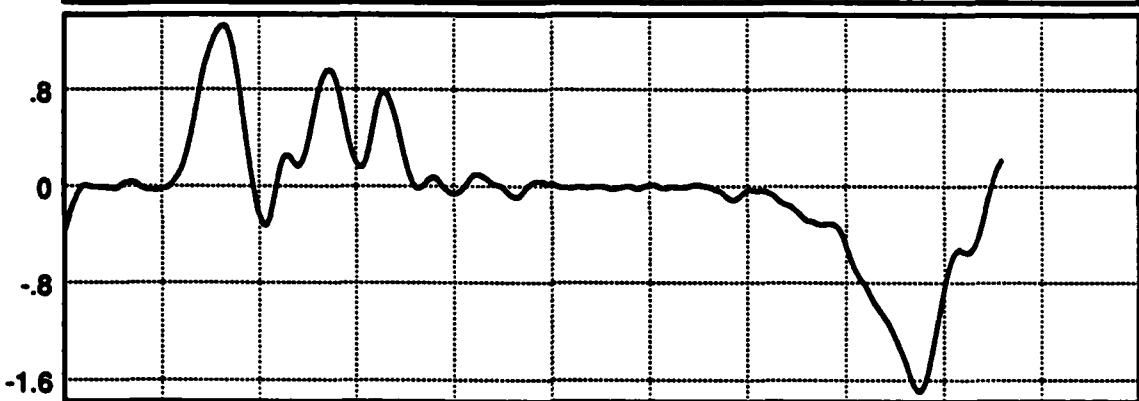
1.33 m/s
-1.69

11.6 G
-15.7

Acceleration (G)



Velocity (m/s)



Belt extension
out of inertia reel (cm)

Time: 0 80 160 240 320 400 (ms)



Figure C-47. Amount of belt extension and the velocity and acceleration of extension for test LX6279.

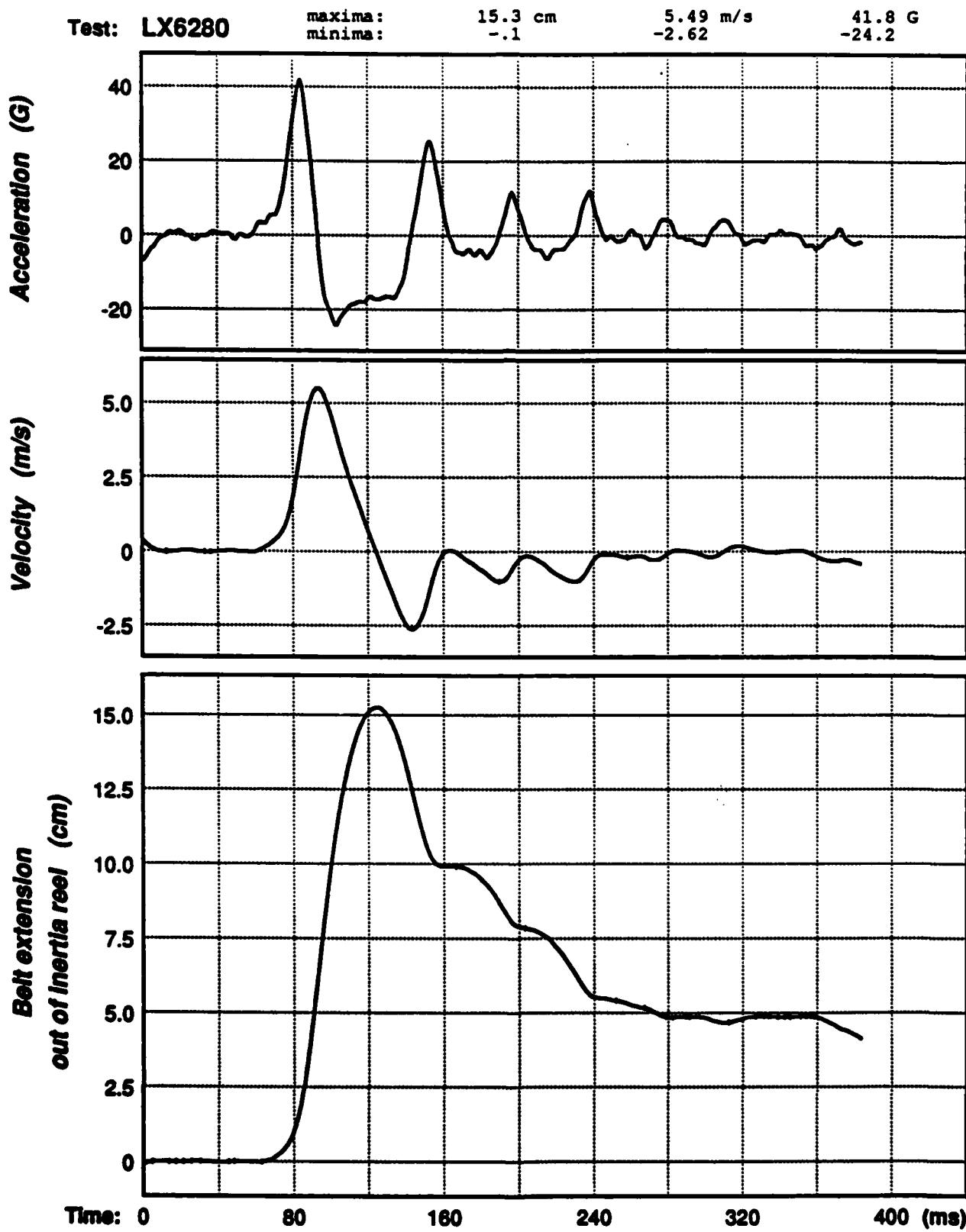


Figure C-48. Amount of belt extension and the velocity and acceleration of extension for test LX6280.

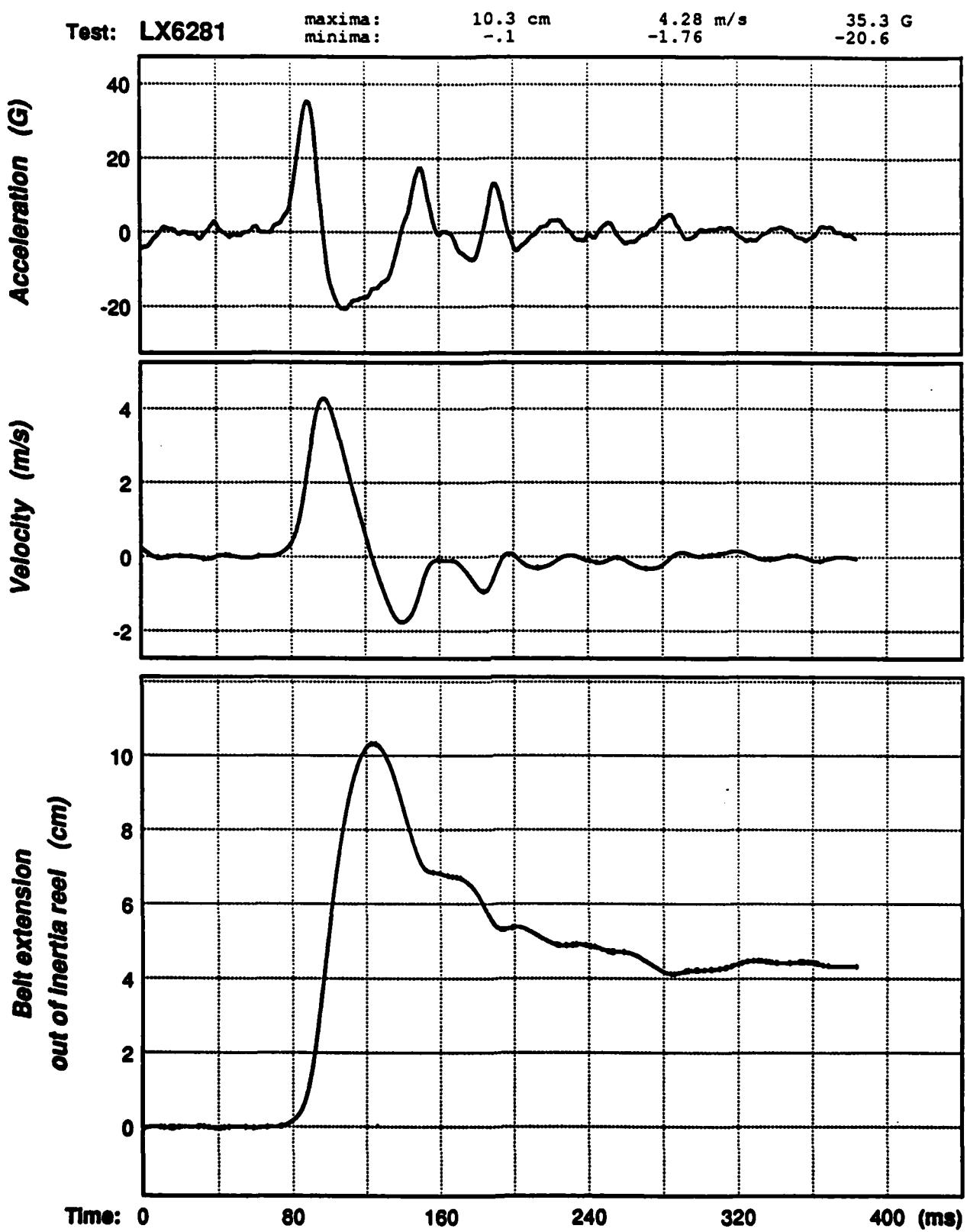


Figure C-49. Amount of belt extension and the velocity and acceleration of extension for test LX6281.

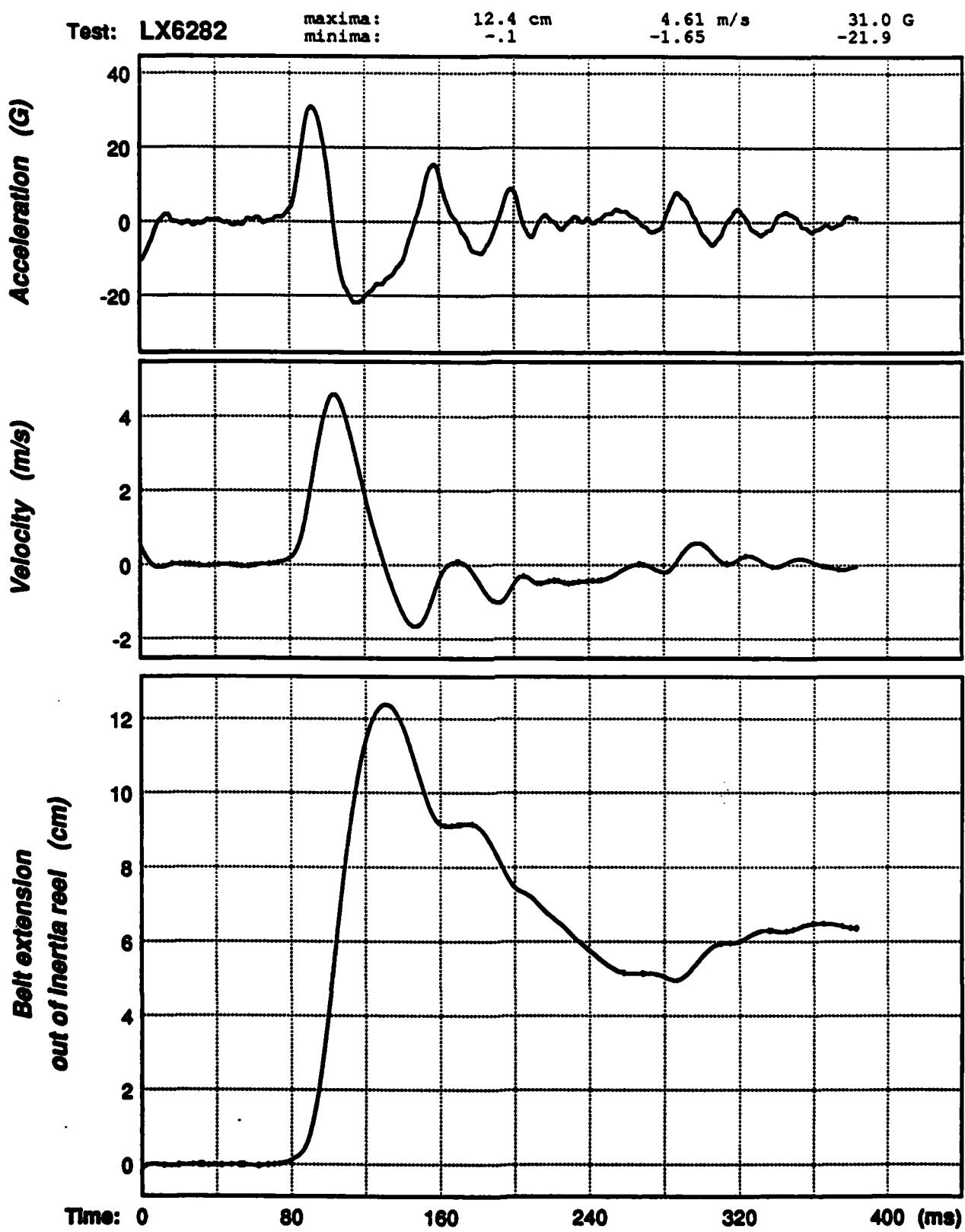


Figure C-50. Amount of belt extension and the velocity and acceleration of extension for test LX6282.

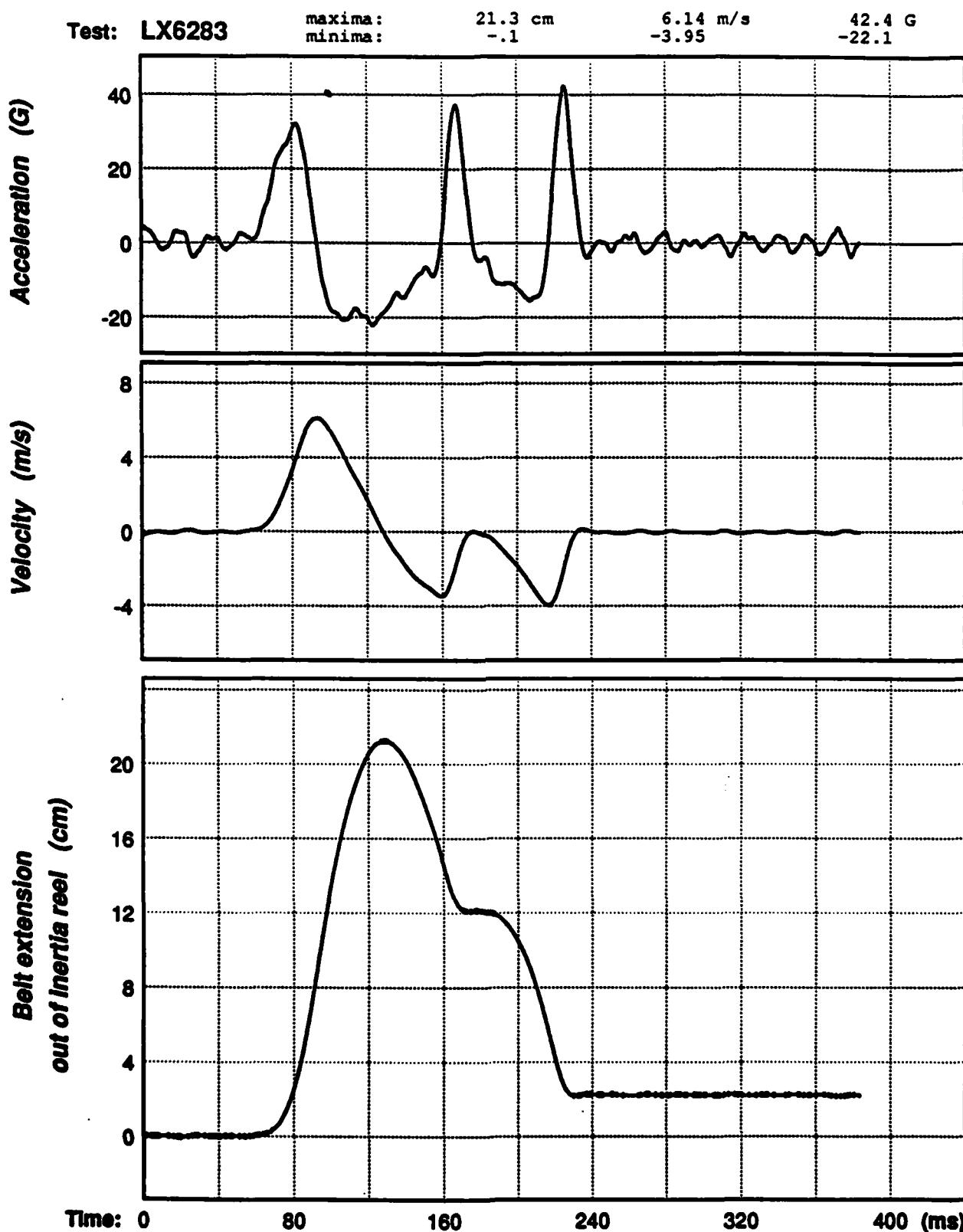


Figure C-51. Amount of belt extension and the velocity and acceleration of extension for test LX6283.